

Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 4: Engineering, Safety and Cost Appraisal

Section 11: Appendices

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Appendix 4.1 - Key Departures

Route 1 Key Departures

Route 3 and 4 Key Departures

**Highways Shortlist Route 1
Key Departures**

Departure No.	Route Option	Sketch Ref:	Departure Description	Location	Reason	Solutions
1	A1/A4	Junction 1a	Successive merge and diverge. Required distance needs to be 3.75 x design speed (TD22/06 Paragraph 4.30). Required is 318.75m (85kph design speed), actual achieved is 270m.	A282 Master string Ch+3730.000 Junction 1a Northbound Merge	Proximity of the two junctions, not practicable to move this slip road elsewhere due to other slip roads and property constraints.	This could be designed out by relocating either Bridge diverge nose or jct 1a merge nose 50m further south or north respectively
2	A1/A4	Junction 1a	Geometric design parameters (TD22/06 Paragraph 4.30) for merging lanes Note 2 : Ghost island merges on urban roads are not permitted.	A282 Master string Ch+3730.000 Junction 1a Northbound Merge	Ghost island is not permitted in an urban scenario therefore a Type D merge is recommended in accordance with Figure 2/3 AP All-Purpose Road Merging Diagram.	Provisional V1 traffic figures indicate that a Type F merge is required in accordance with Figure 2/3 AP All-Purpose Road Merging Diagram.
3	A1/A4	Junction 30/31	Departure from TD22/06 Figure 2/5 AP All-Purpose Road Diverging Diagram	A282 Master string Ch+7290.000 Junction 31 Northbound Diverge	Provisional V1 traffic figures indicate that a Type E diverge is required in accordance with Figure 2/5 AP All-Purpose Road Diverging Diagram.	To allow for future traffic growth and possible results from V2 traffic figures it has been proposed that 3 lanes continue through to the A282 to make 5 lanes merging with the NB tunnel. Therefore only a single lane drop will be proposed instead of two lanes dropped.
4	A1/A4	Junction 30/31	Departure from TD22/06 & TD39/94 Figure 2/3 AP All-Purpose Road Merging Diagram. 3 lane bridge merging with 2 lane tunnel: Type E used with min 1000m Radii on the nearside channel.	A282 Master string Ch+7610.000 Northbound Bridge and Tunnel Merge	There is no guidance on a merge type for a mainline to mainline merge with equal traffic flows and equal design speeds hierarchy.	Guidance required for mainline to mainline merge
5	A1/A4	Junction 30/31	Weaving Length, merge to diverge potentially less than desirable minimum for urban all-purpose roads (TD22/06 Paragraph 4.36). Actual weaving length is 470m.	A282 Master string Ch+7610-8080 Northbound Bridge Merge to A13 diverge	Proximity of the A282 merge with the A13 diverge.	Absolute minimum urban AP weaving length in accordance with Figure 4/14 is circa 250m.
6	A1/A4	Junction 30/31	Departure from TD22/06 & TD39/94 Figure 2/3 AP All-Purpose Road Merging Diagram. 3 lane bridge merging with 2 lane tunnel: Type E used with min 1000m Radii on the nearside channel. Used	A282 Master string Ch+7610.000 Southbound Bridge Merge	There is no guidance on a merge type for a mainline to mainline merge with equal traffic flows and equal design speeds hierarchy.	Guidance required for mainline to mainline merge
7	A1/A4	Junction 30/31	Geometric design parameters (TD22/06 Paragraph 4.30) for merging lanes Note 2 : Ghost island merges on urban roads are not permitted.	A282 Master string Ch+7420.000 Southbound Junction 30 to A282 Interchange Link	It is recommended that the use of Type A / B merge is not permitted for interchange links, therefore a Type D is required.	To allow for future traffic growth and possible results from V2 traffic figures it has been proposed that a Type F lane gain arrangement is used
8	A1/A4	Junction 1a	Weaving Length, merge to diverge potentially less than desirable minimum for urban all-purpose roads (TD22/06 Paragraph 4.36). Actual weaving length is 250m.	A282 Master string Ch+7420.000 Southbound Interchange Link merge to QE II bridge diverge	Proximity of the interchange link merge with the QE II diverge.	Absolute minimum urban AP weaving length in accordance with Figure 4/14 is circa 250m.
9	A1/A4	Junction 1a	Geometric design parameters (TD22/06 Paragraph 4.30) for merging lanes Note 2 : Ghost island merges on urban roads are not permitted.	A282 Master string Ch+8280.000 Southbound A13 to A282 Connector road	It is recommended that the use of Type D merge is required in accordance with Figure 2/3 AP All-Purpose Road Merging Diagram.	To allow for future traffic growth and possible results from V2 traffic figures it has been proposed that a Type F lane gain arrangement is used
10	A1/A4	Junction1b/1a	We are currently using IAN 161 as the design basis for smart motorways. Section 1.5 of this document however states that it is only applicable to motorways up to 4 lanes, and that guidance should be sought from the Highways England Project Manager in other circumstances. Since the A282 is not a motorway, and 5 lanes are planned in places, further guidance regarding which standards to use would be appropriate.	A282 Junction 1a to junction 1b	Standard only applies to motorways of up to 4 lanes and we have 5 lanes (plus the A282 isn't technically a motorway)	Note that if IAN 161 is confirmed as applicable to All-Purpose highway at this location, this potential Departure will be devolved to a Relaxation.
11	A1/A4	Junction1b/1a	It may not be possible to fit in ERA's between J2-1a on either carriageway. These should be provided every 2.5km within a scheme according to IAN 161.	A282 Junction 1a to junction 1b	There is no physical space without additional land take.	Distances between junctions are very short, meaning slip roads could be taken in an emergency. Costs of removing retaining walls and acquiring additional land from adjacent housing would be high.
12	A1/A4	Junction1b/1a	Due to the 5 lane width, gantry-mounted AMI's are likely to be used rather than an MS4 in the verge.	A282 Junction 1a to junction 1b	Visibility of MS4's would not be good from the fifth lane	This approach has been taken on other schemes where 5 lane sections have occurred.
12a	A1/A4	Junction 1a-2	There are 2 very short links on this section that do not have the verge width to use the current HADECS 3 technology, thus they would require a departure either to enforce with the previous HADECS 2 system, or, due to the shortness of the links, not to enforce at all.	A282 Junction 1a to junction 2	Lack of verge width for HADECS 3 installation.	Use HADECS 2 or, given the short length of road involved and the fact it is already a permanent 50mph limit, do not enforce this section.
13	A1/A4	Junction 30/31	Potential departure from TD22/06 for Weaving length between successive merge and diverge.	Junction 30 Westbound A13 On slip from A126, to Westbound A13 off slip to J30,	Downstream connector road geometry and Interchange Link Fork for free-flow southbound A282 traffic movement requires a revised point of intercept with the A13 mainline, east of the 2 lane-drop design for the A13 Congestion Relief scheme, which is to be closed up under the LTC scheme. Consequently, the available weaving length, Act, is reduced to 340m. If "Rural" status is held by the A13 corridor, Act is below the 1 km length stipulated by TD22/06 cl 4.36. If "urban" status is held, this may be below the minimum calculated weave length requirement (as yet unknown).	If "Urban" status is inferred to the A13 by the application of a plated speed limit (50mph), Act is greater than the Absolute Minimum Urban AP weave length of 245m. On receipt of revised turn-movement traffic figures, a further calculation to cl 4.37 will be required to demonstrate compliance with, or departure from, urban weave criteria, or to assess the degree of departure from "rural".
14	A1/A4	Junction 30/31	Potential Departure from TD22/06 cl 3.4, Table 3/1a for Cross-Sections for Connector Roads, to/from Mainline All-Purpose Roads	Junction 30 A282 Northbound to A13 Westbound on-slip connector road.	Currently available traffic figures indicate a required single-lane+ Hard shoulder cross-section of IL1C or IL1D (Rural/Urban). The proposed layout provides for 2 lanes to IL2C or IL2D as an over-provision.	The indicated 2 lane cross section is provided in advance of revised traffic demand figure which are anticipated to be higher than currently available data. Until such times as revised traffic figures are available, and until agreement on Urban/Rural status is agreed, this item is considered to be a <i>Potential</i> departure, only.
15	A1/A4	Junction 30/31	Potential Departure from TD22/06 2.29 for Merge form.	Junction 30 A13 Westbound on-slip	Indicated Merge type C/D(urban) shown in advance of determination of connector road urban/rural status, in the absence of traffic data.	To be reassessed on receipt of updated traffic data. Note that if IAN 161 is confirmed as applicable to All-Purpose highway at this location, this potential Departure will be devolved to a Relaxation.

Departure No.	Route Option	Sketch Ref:	Departure Description	Location	Reason	Solutions
16	A1/A4	Junction 30/31	Departure from TD22/06 cl 2.34 for provision of straight or near straight to back of nose.	Junction 30 A13 Westbound on-slip	Merge occurs on the outside of an approx. 720m radius curve. Preceding connector road geometry and Interchange Forks and proximity with side road overbridge precludes provision of straight or near straight at the back of nose. The incipient curvatures of the merge nosing have been carried-through and transitioned off a straight in advance of the back of nose.	The near-parallel alignment of the connector, compared to the mainline, gives an extended opportunity to assess mainline traffic speeds. Note that the mainline will be limited to 50 (max) mph in free-flow configuration, therefore, speed-matching will be more easily achieved. Further design iterations, at the expense of increase land take and higher structure costs, may render this departure nul.
17	A1/A4	Junction 30/31	Departure from TD22/06 cl 2.34 for provision of straight or near straight to back of nose.	Junction 30 A13 Eastbound on-slip	Connector road geometry preceding the point of merge is constrained by proximity with an existing half-dumbbell junction, new railway under bridge and by a side road overpass immediately following the point of merge. Horizontal radius approaching the back of nose is greater than desirable minimum of 510m with full transition provision.	The intended merge type provides a lane gain which provides considerable opportunity for lane 1 gap determination, speed matching and lane-changing maneuvers. The alignment and gradient of the connector road immediately prior to the nose will not negatively impact upon speed-matching opportunities for the merging lane 2. Visibility will not be impeded by mainline curvature. Further design iterations, at the expense of increase land take and higher structure costs, may render this departure nul.
18	A1/A4	Junction 1a	Departure from TD22/06 cl 2.43 for provision of layout differs from that derived from the use of Figure 2/5 AP.	Junction 1A J1A Southbound Diverge - A282 Southbound after Queen Elizabeth II Bridge	From use of Figure 2/5AP, recommended layouts are either Type D or Type E (2 lane drop). The proposed use of Type D layout will provide a single lane drop from 4 lanes of existing QEII bridge which is more appropriate than providing 2 lane drop as vehicles on QEII bridge on nearside Lane 01 (especially HGVs) will have to weave across 2 lanes if these are not using Junction 1A and this is anticipated on steep downgrade approach of bridge. Also this layout will produce high capacity on through lanes. It is also proposed to use Type D Option 2 Not preferred (auxiliary lane) layout to minimise extent of proposed works to QEII bridge approach (in case if Type D standard layout with ghost island is used).	To be reassessed on receipt of updated traffic data. Note that if IAN 161 is confirmed as applicable to All-Purpose highway at this location, this potential Departure will be devolved to a Relaxation.
19	A1/A4	Junction 1a	Departure from TD22/06 cl 4.30 for substandard spacing between tips of noses of successive diverge and merge	Junction 1A J1A Southbound Diverge - A282 Southbound after Queen Elizabeth II Bridge	It is recommended to use minimum spacing of 3.75V (318.75m in proposed 85kph design speed) as per clause 4.30 TD 22/06.	Due to space restrictions and to minimise works required to existing QEII bridge, it is proposed to use 130m spacing between tips of noses. This proposal least onerous than other option which is to move tip of nose between 3 lanes from QEII bridge and 2 lanes from existing tunnel southbound.
20	A1/A4	Junction 1a	Departure from Standards is required from clause 4.9 TD22/06 for substandard horizontal curvature provided for a loop	Junction 1A J1A diverge loop from A282 mainline southbound	It is recommended to use minimum horizontal curvature of 50m as per Table 4/2 All-purpose but due to space constraints it is proposed to use 38m horizontal radius.	Due to space restrictions, between A282 mainline and merge slip road originates from east roundabout of Junction 1A, it is not possible to use recommended 50m radius. Sufficient carriageway width is provided to cater for large vehicle's swept paths.
21	A1/A4	Junction 1b/1a	Type F Rural 100kph merge	Junction 1B J1B NB Merge	The route has an urban classification, precluding the use of a ghost island merge, but the merging traffic flow indicates a ghost island merge is required	Guidance to be sought from HE regarding application of IAN 161 and whether a shorter ghost island merge is applicable
22	A1/A4	Junction 1a/1b	Narrow hard strip	A282 J1B to 1A	Hard strip to be reduced to 600mm where space is at a premium	It is intended that this section of road is managed Trunk road so the lack of a full hard strip will be less dangerous. 600mm is the minimum set back required to a VRS. Existing situation appears to be less than 1m so departures may already be in force
23	A1/A4	Junction 1a	Type C Rural 100kph merge	Junction 1A J1A SB Merge	The route has an urban classification, precluding the use of a ghost island merge, but the merging traffic flow indicates a ghost island merge is required	Guidance to be sought from HE regarding application of IAN 161 and whether a shorter ghost island merge is applicable
24	A1/A4	Junction 1b/1a	Narrow Lanes	Junction 1B J1B to 1A	Narrow running lanes may be required to avoid land take and extensive demolition and rebuilding of structures	It is intended that this section of road is managed Trunk road so narrow lanes will be less dangerous.
25	A1/A4	Junction 1b/1a	Relaxations in SSD	A282 J1B to 1A	The existing available cross section may not be enough to develop full SSD in all locations.	Guidance to be sought from HE regarding application of IAN 161 and whether combinations of relaxations are allowable
26	A1/A4	Junction 1b/1a	Sub standard weaving lengths	A282 J1B to 1A	Existing junction locations are fixed	Awaiting latest traffic figures. Existing situation so departures may be in place
27	A1/A4	Junction 1b/1a	Possible sub standard super elevation	A282 J1B to 1A	Existing structures such as Bow Lane Rail Bridge NB	Accurate Topographical survey required

Highways Shortlist Routes 3 and 4
Key Departures

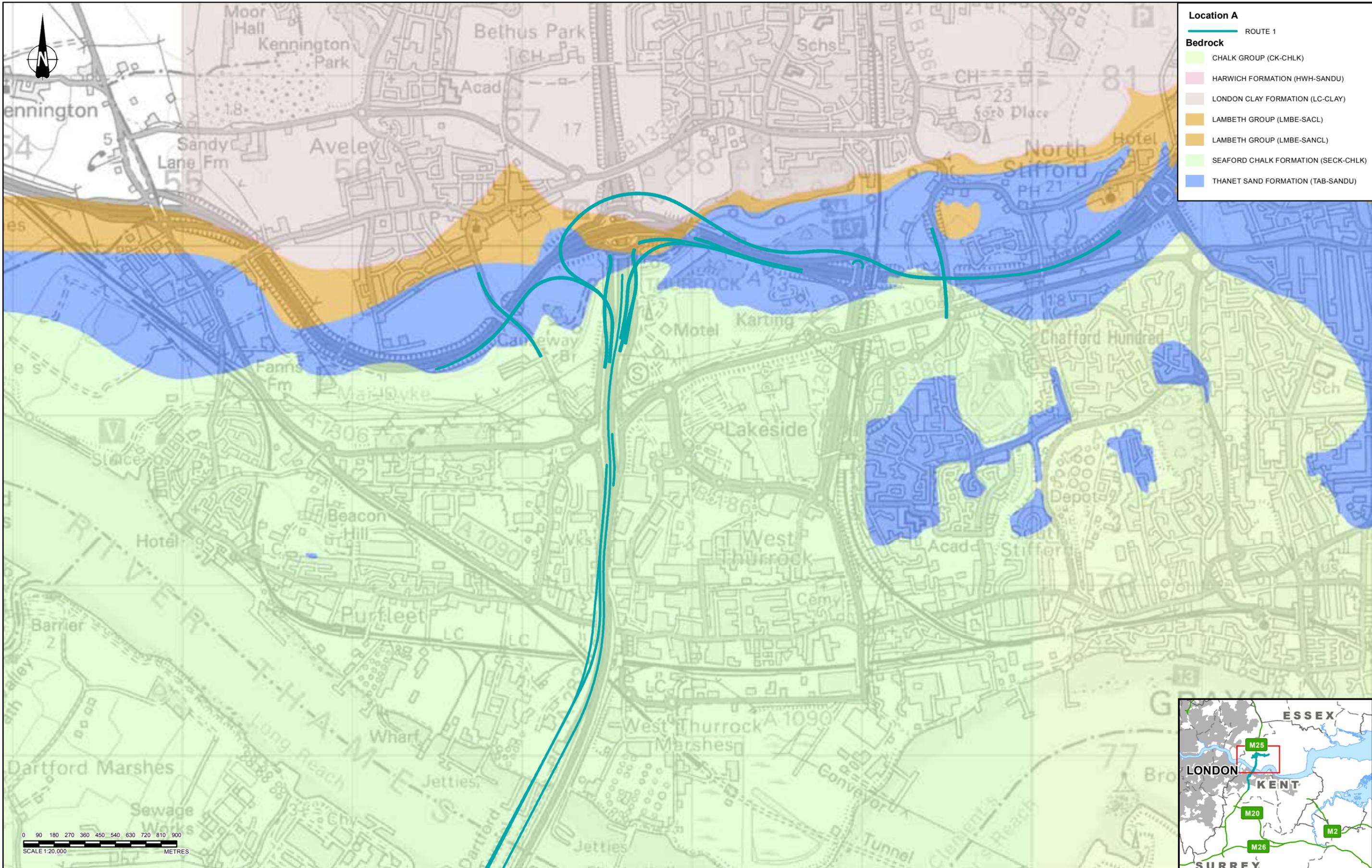
Departure No.	Route Option	Departure Description	Location	Reason	Solutions
3	3	According to Figure 2/3 Motorway Merging Diagram, from TD22/06 pg 2/8, Merge Type F is required, this will require lane gain which makes M25 5 lane.	M25 Northbound Merge Type F required, Type C used	M25 Northbound traffic is 7437, this requires 5 lanes and Type F merge, (with lane gain) to avoid adding an extra lane to the M25 , to make it 5 lanes, Merge Type C was chosen.	Both solutions require instruction from the Overseeing Organization as 5 lane motorway is a departure as well as using Type C merge.
4	3	According to Figure 2/5 Motorway Diverging Diagram, from TD22/06 pg 2/17, Diverge Type D is required, this will require lane drop.	M25 Southbound Diverge Type D required, Type B used	M25 is already 4 lanes, using layout Type D, requires a lane drop, that means M25 needs 5 lanes, to avoid adding an extra lane, diverge Type B was chosen.	Both solutions require instruction from the Overseeing Organization as 5 lane motorway is a departure as well as using Type B diverge.
5	3	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.35). Actual weaving length is approximately 900m.	A13 Eastbound Between LTC southbound to A13 EB slip road and diverge at existing EB Orsett Cock Interchange	Proximity of the two junctions, not practicable to move this slip road elsewhere due to other slip roads and property constraints.	
6	3	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.35). Actual weaving length is approximately 860m.	A13 Westbound Between LTC northbound to A13 westbound on slip and diverge at existing A1012 junction	Proximity of the two junctions, not practicable to move this slip road elsewhere due to other slip roads and property constraints.	
7	3	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.35). Actual weaving length is approximately 820m.	A13 Eastbound Between A13 eastbound to LTC northbound off slip and the existing merge at the A1012 junction	Proximity of the two junctions, not practicable to move this slip road elsewhere due to other slip roads and property constraints.	
8	3	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.35). Actual weaving length is approximately 635m.	A13 Westbound Between A13 Orsett Cock WB merge and A13 westbound to LTC southbound off slip	Proximity of the two junctions, not practicable to move this slip road elsewhere due to other slip roads and property constraints.	Currently less than 1km
9	3	According to Figure 2/5 All Purpose Diverging Diagram, from TD22/06 pg2/8, Type D is required, this will require a lane drop	Brentwood Road Diverge Diverge Type D required, Type B used	Upstream mainline flow indicates three lanes, so a lane drop would be appropriate here. LTC mainline proposed as a D2AP	
10	3	According to Figure 2/3 All Purpose Merging Diagram, from TD22/06 pg 2/8, Merge Type F is required, this will require lane gain, Type C is proposed.	Brentwood Road Merge Type F required Type C proposed	Downstream mainline flow indicates three lanes, so a lane gain would be appropriate here. LTC mainline proposed as a D2AP	

Departure No.	Route Option	Departure Description	Location	Reason	Solutions
1	4	According to Figure 2/3 Motorway Merging Diagram, from TD22/06 pg 2/8, Merge Type F is required, this will require lane gain which makes M25 5 lane.	M25 Northbound Merge Type F required, Type C Proposed	M25 Northbound traffic is 7437, this requires 5 lanes and Type F merge, (with lane gain) to avoid adding an extra lane to the M25 , to make it 5 lanes, Merge Type C was chosen.	Both solutions require instruction from the Overseeing Organization as 5 lane motorway is a departure as well as using Type C merge.
2	4	Distance between successive merges is approximately 225m, less than 3.75V (450m), according to TD22/06 para 4.30.	A127 Eastbound Successive merges	Moving the merge towards East will take it over B186 requiring additional structure.	Merge can be moved eastbound on the A127, may require additional structure over B186.
3	4	Distance between successive diverges is approximately 110m, less than 3.75V (450m) according to TD22/06 paragraph 4.30.	A13 Slip road from LTC northbound to A13 westbound and eastbound	Slip road required for all movement free flow junction. Due to proximity of properties not possible to separate these slip roads.	Proximity of properties restricts options at this junction.
4	4	Successive diverges. Required distance needs to be 3.75 x design speed (TD22/06 Paragraph 4.30). Required on A13 is 320m (85kph design speed), actually achieved is 110m.	A13 Slip road A13 to LTC northbound and southbound	Slip road required for all movement free flow junction. Due to proximity of properties not possible to separate these slip roads.	Proximity of properties restricts options at this junction.
5	4	According to Figure 2/5 All Purpose Diverging Diagram, from TD22/06 pg 2/8, Diverge Type D is required, this will require lane drop, Type B is proposed.	A13 Slip road A13 to LTC northbound and southbound	The merging traffic values are close to the boundary between the two types of merges.	From the traffic values looks like LTC should be 3 lanes.
6	4	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.36). Actual weaving length is 740m.	A13 westbound Merge from A1014 junction to A13 diverge to LTC southbound.	The proximity of the two junctions results in substandard weaving length. LTC can not practically move further west due to properties and interaction with A1089 / A13 junction which would also create issues with weaving length.	No alternative without creating further departures on weaving length and possible geometry departures.
7	4	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.36). Actual weaving length is 679m.	A13 westbound Merge from LTC southbound to A13 eastbound to diverge for A1014 junction.	The proximity of the two junctions results in substandard weaving length. LTC can not practically move further west due to properties and interaction with A1089 / A13 junction which would also create issues with weaving length.	No alternative without creating further departures on weaving length and possible geometry departures.
8	4	According to Figure 2/3 All Purpose Merging Diagram, from TD22/06 pg 2/8, Merge Type E is required, this will require lane gain, since traffic values are small, Type C is proposed.	A13 Slip road from LTC northbound and southbound to A13 westbound	Lane gain would result in serious weaving problems due to the proximity with Orsett Cock Junction.	Proximity with other slip restricts options at this junction
9	4	Successive merges. Required distance needs to be 3.75 x design speed (TD22/06 Paragraph 4.30). Required on interchange link is 320m (85kph design speed), actual achieved is 100m.	A13 Slip road from A13 eastbound and westbound to LTC northbound	Insufficient space to separate these links and merge onto the A13 without additional property take.	
10	4	According to Figure 2/3 All Purpose Merging Diagram, from TD22/06 pg 2/8, Merge Type E is required, this will require lane gain, since traffic values are small, Type C is proposed.	A13 Slip road from A13 eastbound and westbound to LTC northbound	Upstream traffic flow (1134) and merge flow (1031) don't require a lane gain	

Departure No.	Route Option	Departure Description	Location	Reason	Solutions
1	ESL	Weaving Length, merge to diverge less than desirable minimum of 2km for motorway (TD22/06 Paragraph 4.35). Actual weaving length is 1250m.	M2 southbound LTC southbound slip road to A228 diverge at 'dumbbell' junction	Proximity of the LTC merge and existing A228 junction.	No scope for altering the location of the merge, lane gain required through to A228 junction.
2	ESL	Weaving Length, diverge to merge less than desirable minimum of 2km for motorway (TD22/06 Paragraph 4.35). Actual weaving length is 1100m.	M2 northbound LTC northbound slip road from A228 diverge at 'dumbbell' junction	Proximity of the A228 merge with the LTC diverge.	No scope for altering the location of the merge, lane gain required from A228 junction.
3	ESL	Successive merges. Required distance needs to be 3.75V (TD22/06 para 4.30) which is 450m, actual is 240m.	M2 southbound LTC southbound slip road to A289 southbound slip road	Proximity of the two slip roads.	
4	ESL	Weaving Length, merge to diverge less than desirable minimum of 1km for rural all-purpose roads (TD22/06 Paragraph 4.36). Actual weaving length is 582m.	A2 eastbound Brewers Road merge to LTC northbound diverge.	Proximity of the two slip roads.	Potentially could close Brewers Road slip road, traffic would use westbound A2 and the return eastbound at existing junction at Hever Court Road.
5	ESL	Successive diverges. Required distance needs to be 3.75 x design speed (TD22/06 Paragraph 4.30). Required on slip road is 320m (85kph design speed), actual achieved is 270	A2 eastbound A2 eastbound to LTC northbound slip road	Proximity of diverge from A2 and diverge on slip road to the A289 and A2.	Need to review traffic figures to determine if all slip roads are required.

Appendix 4.2 – Geotechnical Drawings

Location A Geological Map Bedrock (Sheet 1 of 2)
Location A Geological Map Bedrock (Sheet 2 of 2)
Location A Geological Map Drift (Sheet 1 of 2)
Location A Geological Map Drift (Sheet 2 of 2)
Route 1 River Crossing: Bridge Geological Long Section (Sheet 1 of 1)
Route 1 Geological Long Section
Location C Geological Map Bedrock (Sheet 1 of 2)
Location C Geological Map Bedrock (Sheet 2 of 2)
Location C Geological Map Drift (Sheet 1 of 2)
Location C Geological Map Drift (Sheet 2 of 2)
Routes 3 and 4 River Crossing: Bored Tunnel Geological Long Section (Sheet 1 of 1)
Route 3 Eastern Southern Link Geological Long Section
Route 3 Western Southern Link Geological Long Section
Route 4 Eastern Southern Link Geological Long Section
Route 4 Western Southern Link Geological Long Section

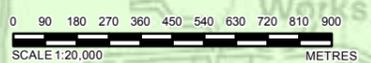


Location A

ROUTE 1

Bedrock

- CHALK GROUP (CK-CHLK)
- HARWICH FORMATION (HWH-SANDU)
- LONDON CLAY FORMATION (LC-CLAY)
- LAMBETH GROUP (LMBE-SACL)
- LAMBETH GROUP (LMBE-SANCL)
- SEAFORD CHALK FORMATION (SECK-CHLK)
- THANET SAND FORMATION (TAB-SANDU)

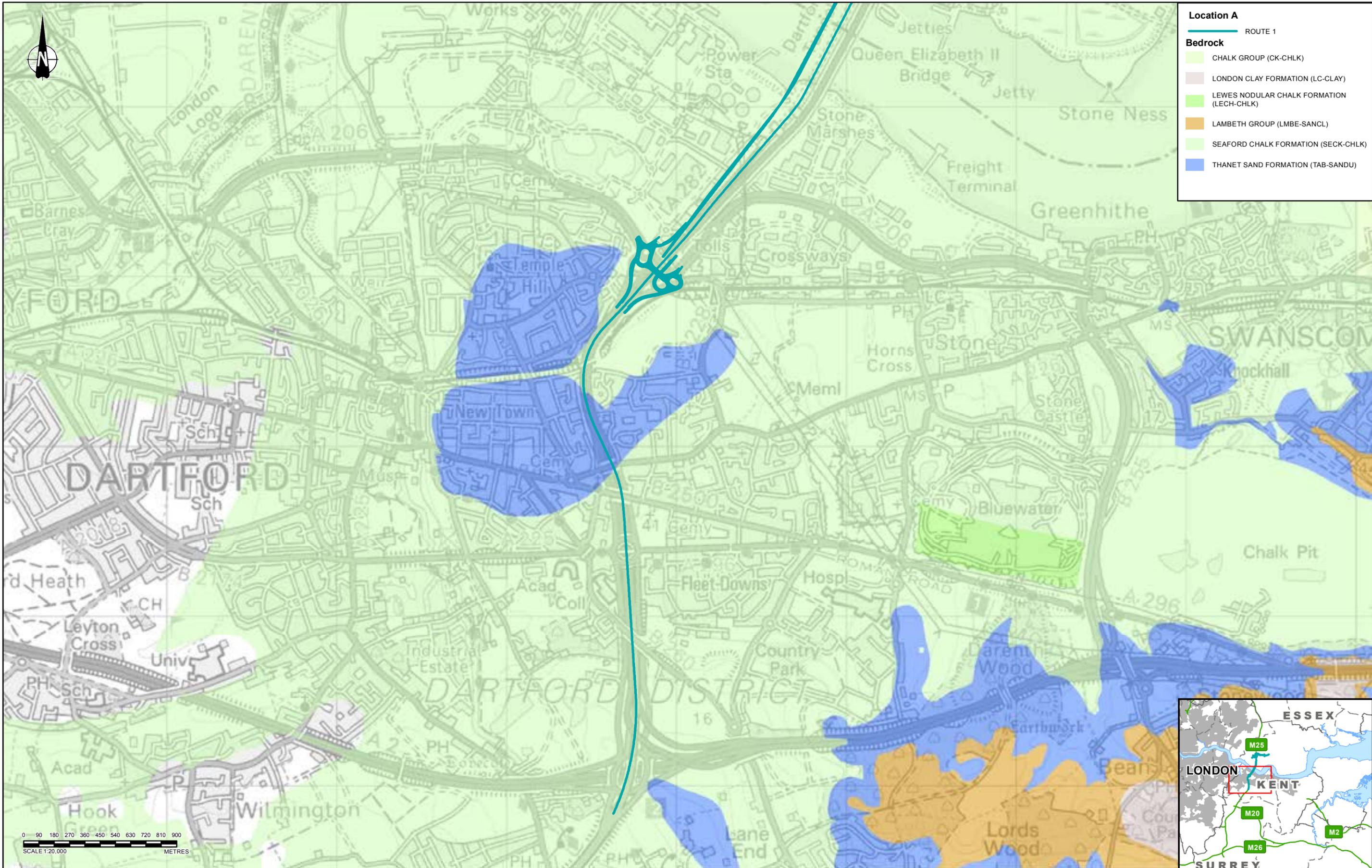


ILLUSTRATIVE DESIGN
 THE DESIGN SHOWN ON THESE DRAWINGS IS ILLUSTRATIVE AND MAY BE SUBJECT TO CHANGE IN LATER STAGES OF THE SCHEME DEVELOPMENT

 Halcrow Hyder Joint Venture Burderop Park Swindon, SN4 0QD Tel. +44(0)1793 812479 	Client highways england	Project LOWER THAMES CROSSING	Status S5	Revision P01
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Project No. HA 540039 Originator HHJ Original Size A3		Drawing number HA540039-HHJ-HGT-AZZZZZZZ-DR-GT-007		

P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd

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Location A

ROUTE 1

Bedrock

- CHALK GROUP (CK-CHLK)
- LONDON CLAY FORMATION (LC-CLAY)
- LEWES NODULAR CHALK FORMATION (LECH-CHLK)
- LAMBETH GROUP (LMBE-SANCL)
- SEAFORD CHALK FORMATION (SECK-CHLK)
- THANET SAND FORMATION (TAB-SANDU)



P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd

ILLUSTRATIVE DESIGN
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Client **highways england**

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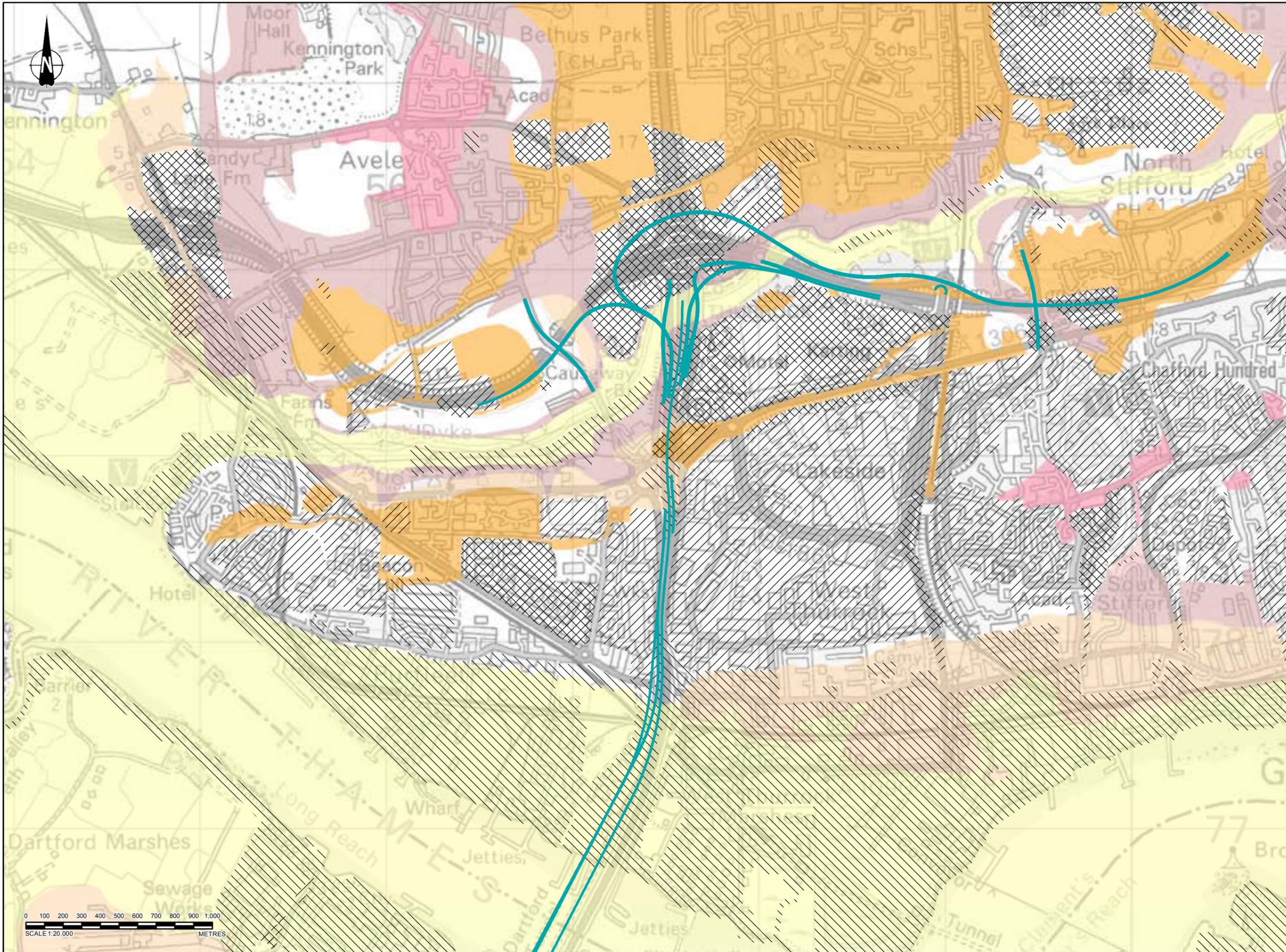
Halcrow **Hyder**

Project **LOWER THAMES CROSSING**

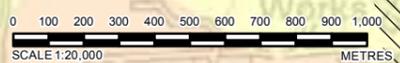
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Drawn By	D Delgado	Checked By	C Cooper
Approved By	J Baple	Project No.	HA PIN HA540039
Originator	HHJ	Original Size	A3
Drawing number	HA540039-HHJ-HGT-AZZZZZZZ-DR-GT-008		

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- Location A**
- ROUTE 1
 - Drift**
 - ALLUVIUM (ALV-Z)
 - BOYN HILL GRAVEL MEMBER (BHT-XSV)
 - BLACK PARK GRAVEL MEMBER (BPGR-XSV)
 - HEAD (HEAD-C)
 - HEAD (HEAD-XVSZ)
 - ILFORD SILT MEMBER (ILSI-Z)
 - LYNCH HILL GRAVEL MEMBER (LHGR-XSV)
 - TAPLOW GRAVEL FORMATION (TPGR-XSV)
 - TIDAL RIVER OR CREEK DEPOSITS (TRD-Z)
 - MADE GROUND (MGR-ARTDP)
 - MADE GROUND (MGR-UNKNOWN)
 - WORKED GROUND (WGR-UNKNOWN)
 - WORKED GROUND (WGR-VOID)
 - INFILLED GROUND (WMGR-ARTDP)
 - INFILLED GROUND (WMGR-UNKNOWN)



ILLUSTRATIVE DESIGN
 THE DESIGN SHOWN ON THESE DRAWINGS IS ILLUSTRATIVE AND MAY BE SUBJECT TO CHANGE IN LATER STAGES OF THE SCHEME DEVELOPMENT

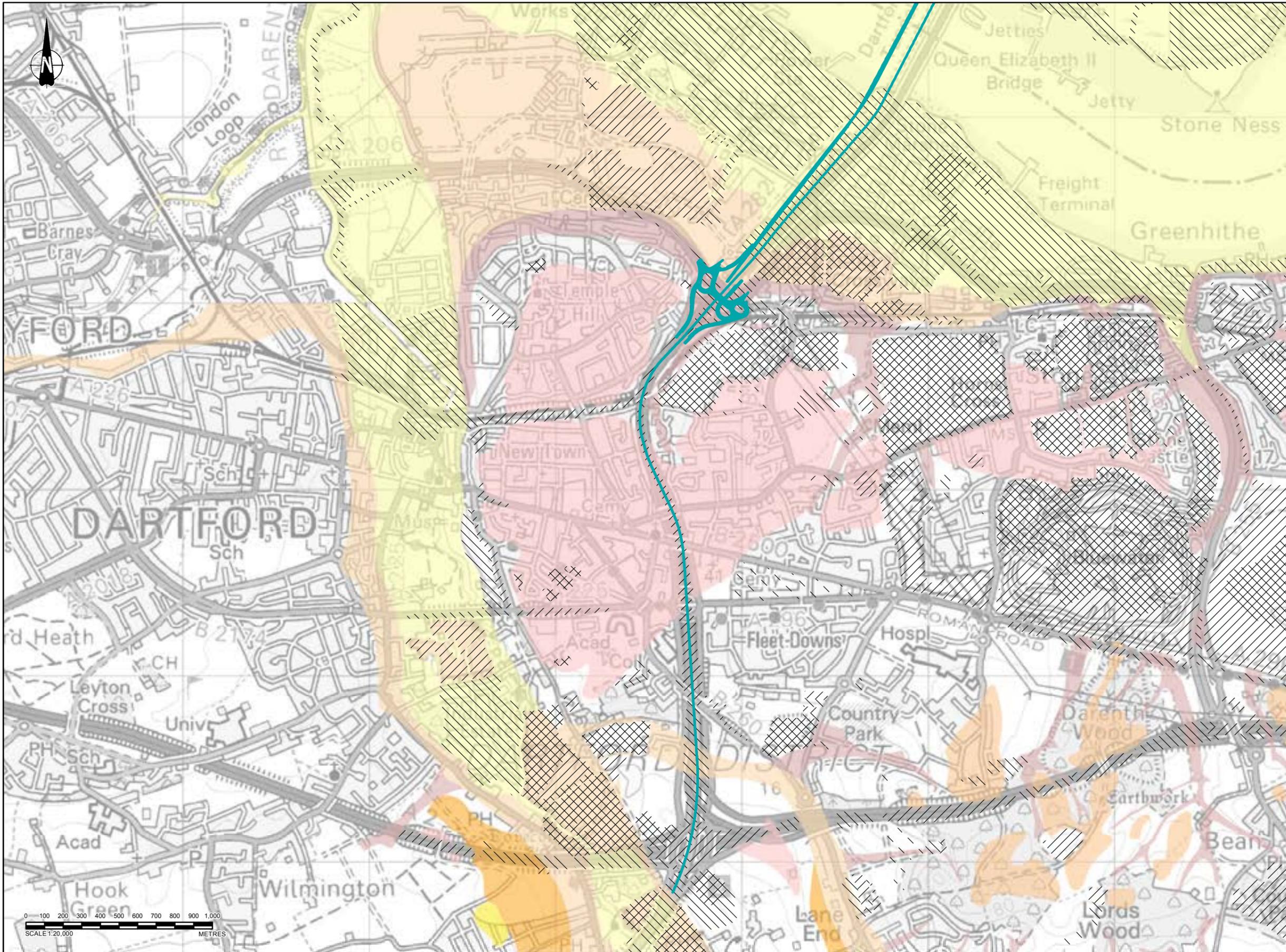
Halcrow Hyder Joint Venture
 Burderop Park
 Swindon, SN4 0QD
 Tel. +44(0)1793 812479

Project: LOWER THAMES CROSSING
 Drawing title: Location A Geological Map - Drift Sheet 1 of 2

Status	S5	Revision	P01
Scale	As Shown	Date	18-01-2016
Drawn By	D Delgado		
Checked By	C Cooper		
Approved By	J Baple		
Project No.	HA PIN HA540039	Originator	HHJ
Drawing number	HA540039-HHJ-HGT-AZZZZZZZ-DR-GT-005		
Original Size	A3		

P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd

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Location A

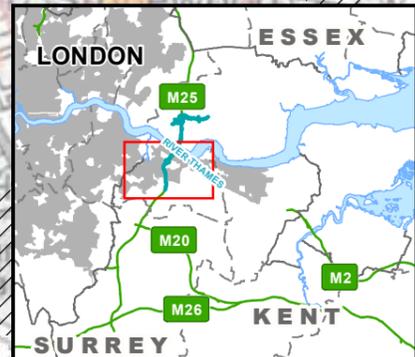
ROUTE 1

Drift

- ALLUVIUM (ALV-Z)
- BOYN HILL GRAVEL MEMBER (BHT-XSV)
- DARTFORD SILT MEMBER (DASI-Z)
- HEAD (HEAD-C)
- HEAD (HEAD-XSC)
- HEAD (HEAD-XSV)
- HEAD (HEAD-XVSZ)
- LYNCH HILL GRAVEL MEMBER (LHGR-XSV)
- RIVER TERRACE DEPOSITS (RTDU-XSV)
- TAPLOW GRAVEL FORMATION (TPGR-XSV)
- TIDAL RIVER OR CREEK DEPOSITS (TRD-Z)

Ground Conditions

- LANDSCAPED GROUND (LSGR-UKNOWN)
- MADE GROUND (MGR-ARTDP)
- MADE GROUND (MGR-UKNOWN)
- WORKED GROUND (WGR-UKNOWN)
- WORKED GROUND (WGR-VOID)
- INFILLED GROUND (WMGR-ARTDP)



P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd

ILLUSTRATIVE DESIGN
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Client

Halcrow Hyder Joint Venture
Burderop Park
Swindon, SN4 0QD
Tel. +44(0)1793 812479

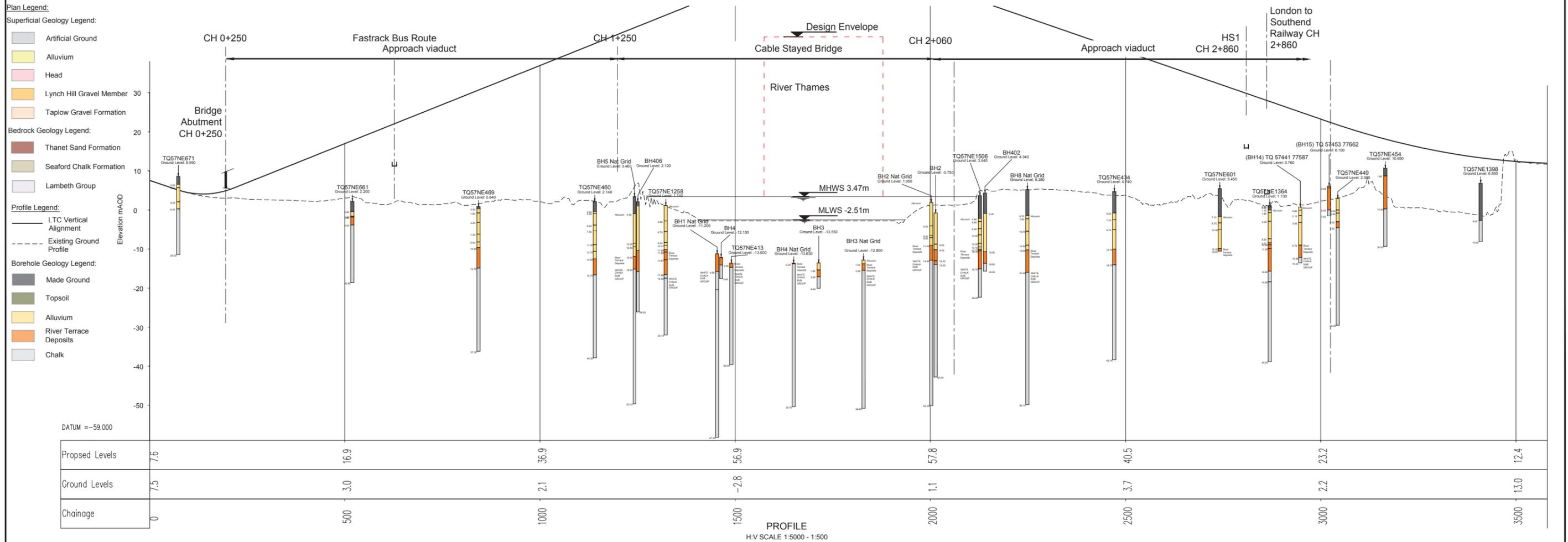
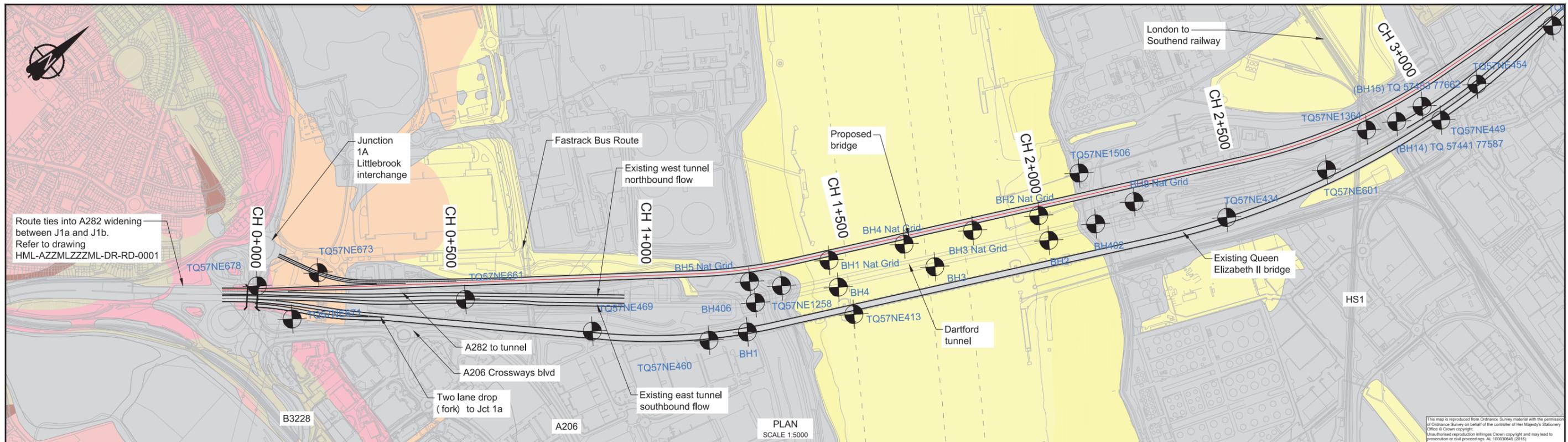
Project

LOWER THAMES CROSSING

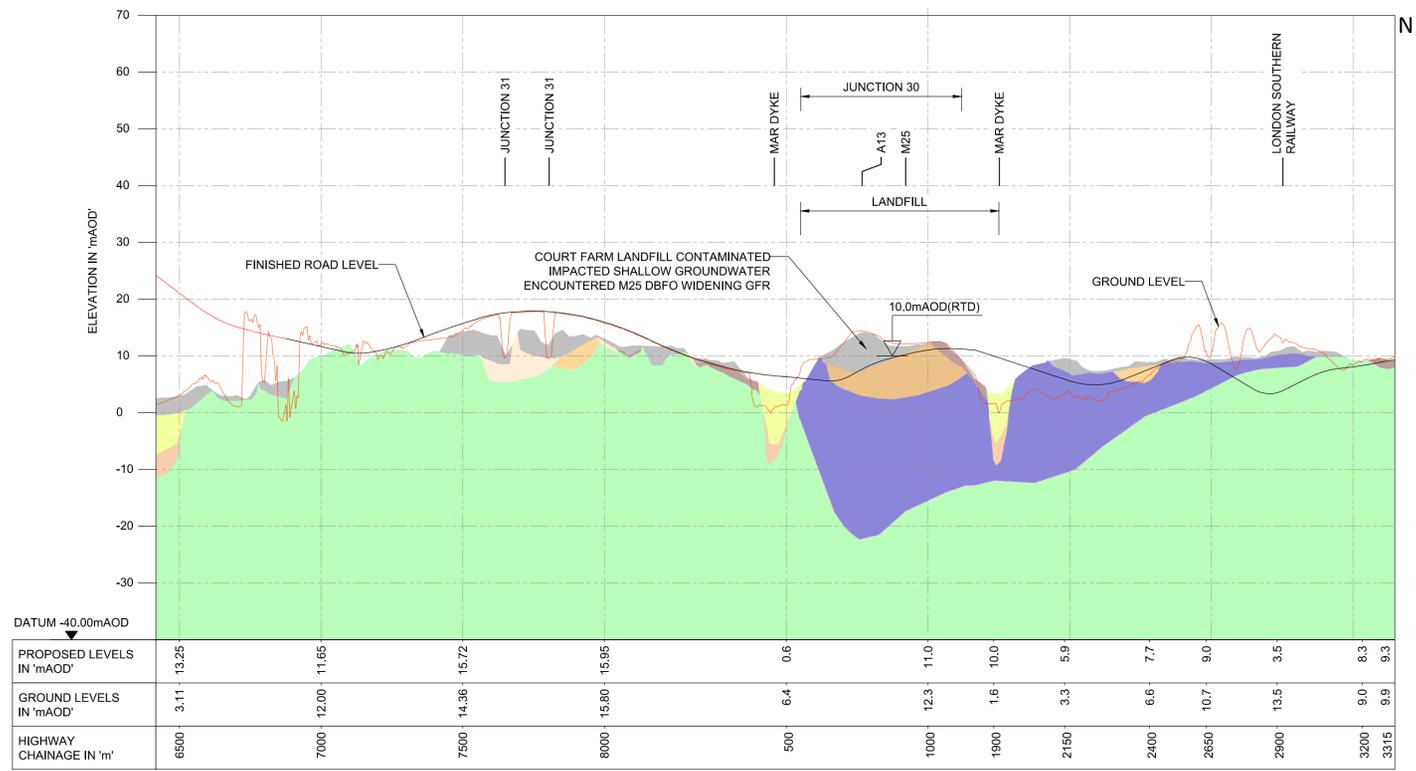
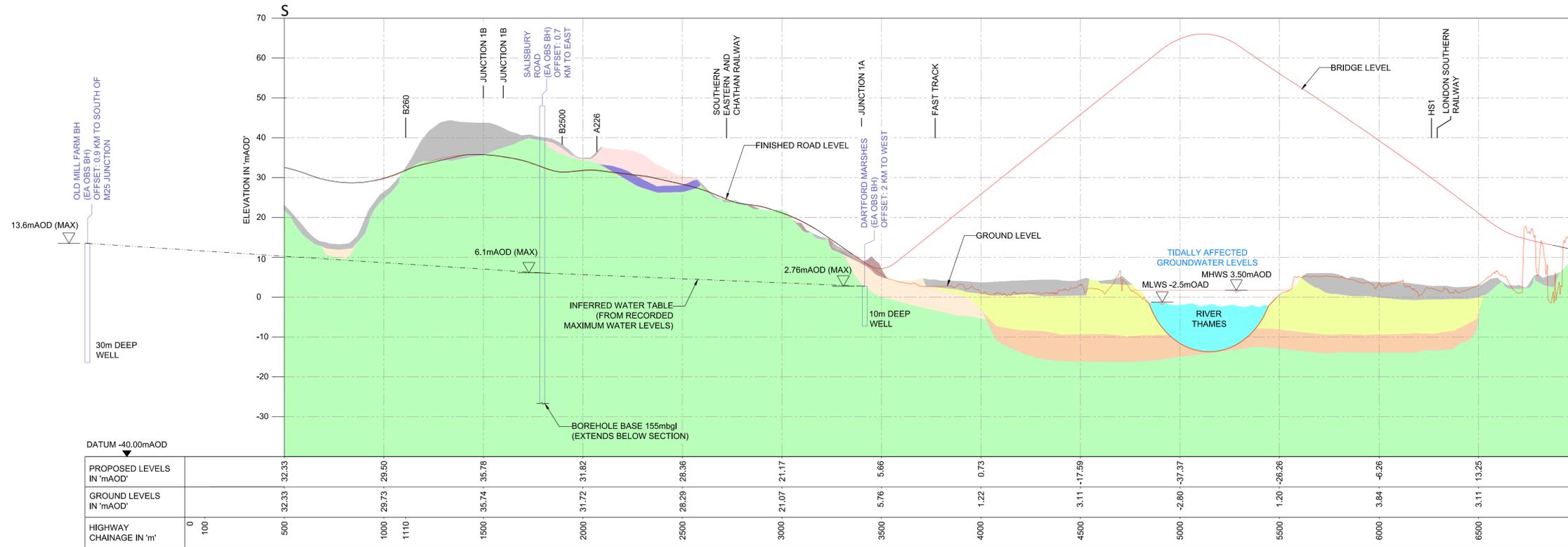
Drawing title

**Location A
Geological Map - Drift
Sheet 2 of 2**

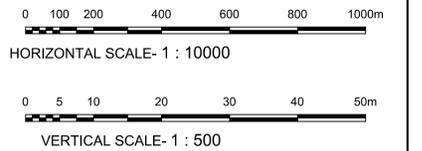
Status	S5	Revision	P01
Scale	As Shown	Date	18-01-2016
Drawn By	D Delgado	Checked By	C Cooper
Approved By	J Baple	Project No.	HA PIN HA540039
Originator	HHJ	Original Size	A3
Drawing number	HA540039-HHJ-HGT-AZZZZZZZ-DR-GT-006		



<p>0 50 100 150 200 250 300 350 400 450 500</p> <p>SCALE 1:5000 (A1)</p> <p>SCALE 1:10000 (A3)</p> <p>METRES</p>		<p>ILLUSTRATIVE DESIGN</p> <p>THE DESIGN SHOWN ON THESE DRAWINGS IS ILLUSTRATIVE AND MAY BE SUBJECT TO CHANGE IN LATER STAGES OF THE SCHEME DEVELOPMENT</p>	<p>Client: highways england</p> <p>Halcrow Hyder Joint Venture</p> <p>Burderop Park Swindon, SN4 0QD Tel: +44(0)1793 812479</p>		<p>Project: LOWER THAMES CROSSING</p> <p>Drawing title: Route 1 River Crossing: Bridge Geological Long Section</p> <p>Sheet 1 of 1</p>		<p>Status: S5</p> <p>Scale: AS SHOWN</p> <p>Drawn By: M. GAMLIN</p> <p>Checked By: C. COOPER</p> <p>Approved By: J. BAPLE</p> <p>Project No.: HA PIN HA540039</p> <p>Drawing number: HA540039-HHJ-HGT-AA0MCZZZML-DR-GT-001</p>		<p>Revision: P01</p> <p>Date: 18/01/2016</p> <p>Original Size: A1</p>	
<p>0 10 20 30 40 50</p> <p>SCALE 1:500 (A1)</p> <p>SCALE 1:1000 (A3)</p> <p>METRES</p>			<p>Client: Halcrow Hyder</p>		<p>Project: LOWER THAMES CROSSING</p>		<p>Status: S5</p> <p>Scale: AS SHOWN</p> <p>Drawn By: M. GAMLIN</p> <p>Checked By: C. COOPER</p> <p>Approved By: J. BAPLE</p> <p>Project No.: HA PIN HA540039</p> <p>Drawing number: HA540039-HHJ-HGT-AA0MCZZZML-DR-GT-001</p>		<p>Revision: P01</p> <p>Date: 18/01/2016</p> <p>Original Size: A1</p>	



GEOLOGICAL LONG SECTION
1 : 10000 HORIZ. & 1 : 500 VERT.



ILLUSTRATIVE DESIGN

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PATTERN	DETAIL
	GROUNDWATER LEVEL (MAXIMUM RECORDED UNLESS OTHERWISE STATED)

PATTERN	DETAIL	PATTERN	DETAIL
	HEAD		ALLUVIUM
	LONDON CLAY		RIVER TERRACE DEPOSITS
	LAMBETH GROUP		LYNCH HILL GRAVEL
	THANET FORMATION		HARWICH FORMATION
	CHALK GROUP		BOYN HILL GRAVEL
	TAPLOW GRAVEL		WORKING GROUND

Client

highways england

Halcrow Hyder Joint Venture
Burderop Park
Swindon, SN4 0QD
Tel. +44(0)1793 812479

Project

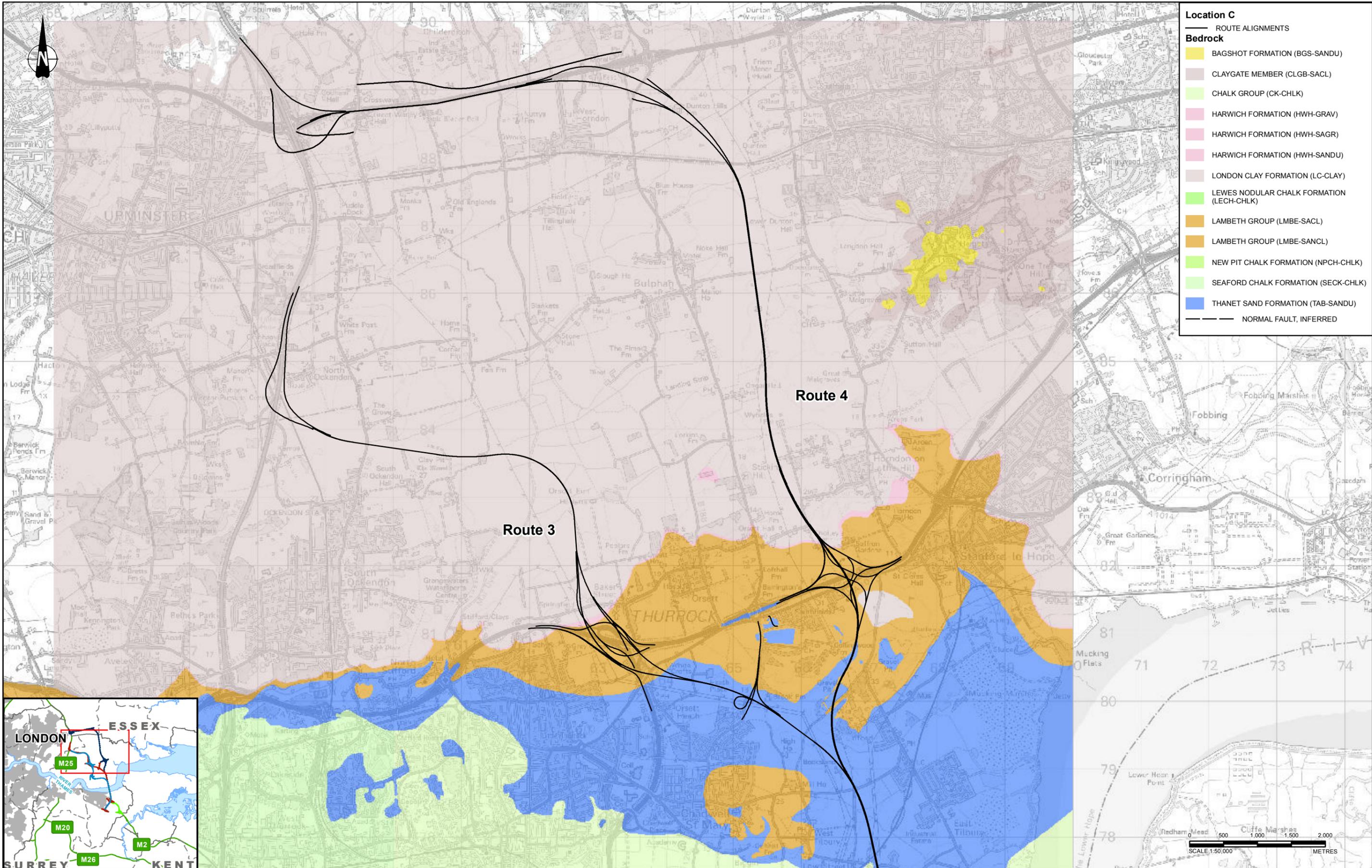
LOWER THAMES CROSSING

Drawing title

Route 1 Geological Long Section

Status	S5	Revision	P02
Scale	1:1200 @ A1	Date	12.08.16
Drawn By	Ashok A		
Checked By	C Cooper		
Approved By	J Baple		
Project No.	HA PIN I Originator	Original Size	A1
Drawing number		HA540039-HHJ-HGT-AZZMLZZZML-DR-GT-001	

Rev	Status	Rev. Date	Purpose of revision	Drawn	Check'd	Apprv'd
P02	S5	12.08.16	Post Consultation SAR Issue	AA	CC	JB
P01	S4	15.02.16	First Issue	AA	CC	JB



- Location C**
- ROUTE ALIGNMENTS
- Bedrock**
- BAGSHOT FORMATION (BGS-SANDU)
 - CLAYGATE MEMBER (CLGB-SACL)
 - CHALK GROUP (CK-CHLK)
 - HARWICH FORMATION (HWH-GRAV)
 - HARWICH FORMATION (HWH-SAGR)
 - HARWICH FORMATION (HWH-SANDU)
 - LONDON CLAY FORMATION (LC-CLAY)
 - LEWES NODULAR CHALK FORMATION (LECH-CHLK)
 - LAMBETH GROUP (LMBE-SACL)
 - LAMBETH GROUP (LMBE-SANCL)
 - NEW PIT CHALK FORMATION (NPCH-CHLK)
 - SEAFORD CHALK FORMATION (SECK-CHLK)
 - THANET SAND FORMATION (TAB-SANDU)
 - NORMAL FAULT, INFERRED



ILLUSTRATIVE
DESIGN

P02	S5	12-08-2016	POST CONSULTATION SAR ISSUE	MG	CC	JB
P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chkd	Apprv
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Client

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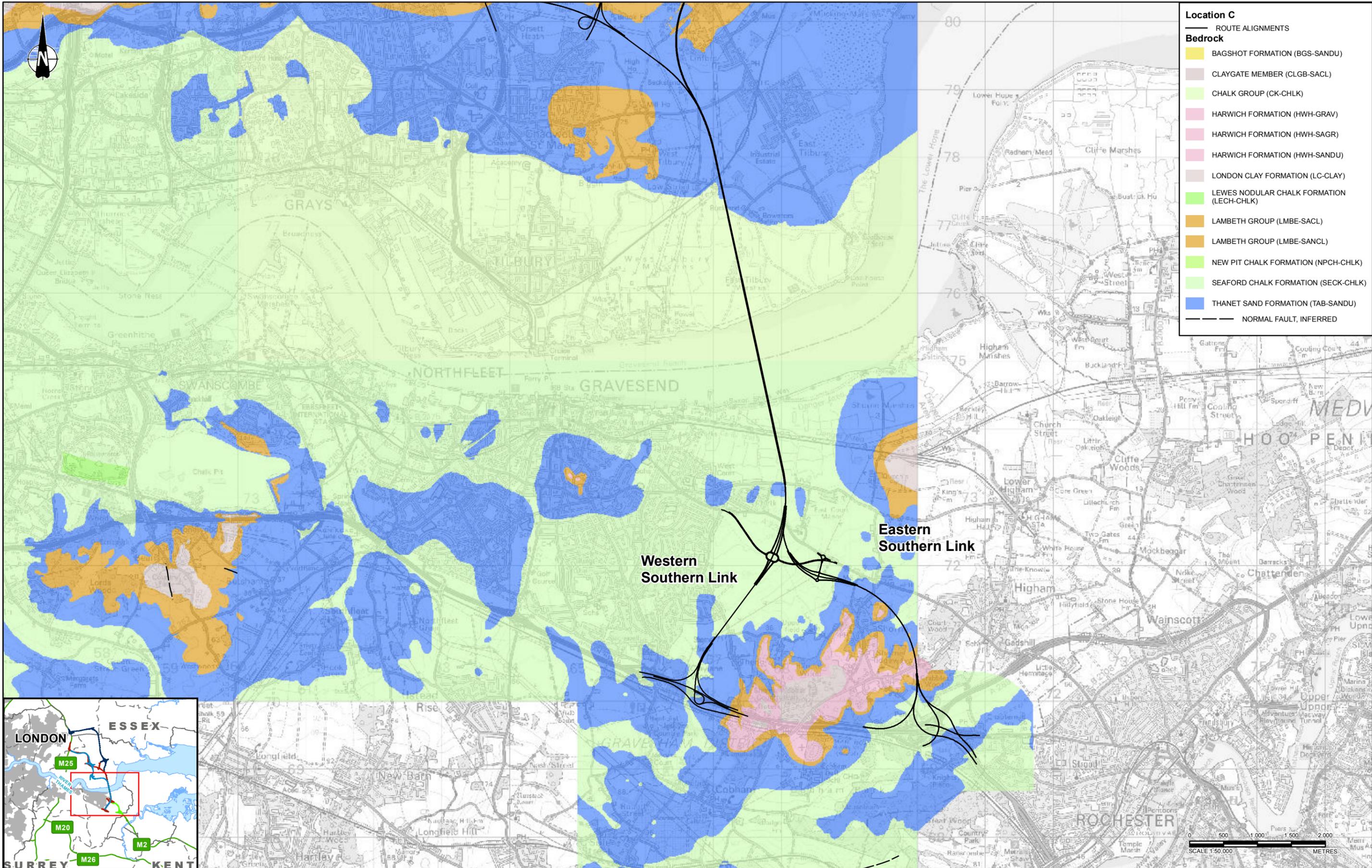
Project

LOWER THAMES CROSSING

Drawing title

Location C
Geological Map - Bedrock
Sheet 1 of 2

Status	S5	Revision	P02
Scale	As Shown	Date	09-08-2016
Drawn By	D Delgado		
Checked By	C Cooper		
Approved By	J Baple		
Project No.	HA PIN	Originator	Original Size
	HA540039	HHJ	A3
Drawing number	HA540039-HHJ-HGT-CZZZZZZZ-DR-GT-007		



- Location C**
- ROUTE ALIGNMENTS
- Bedrock**
- BAGSHOT FORMATION (BGS-SANDU)
 - CLAYGATE MEMBER (CLGB-SACL)
 - CHALK GROUP (CK-CHLK)
 - HARWICH FORMATION (HWH-GRAV)
 - HARWICH FORMATION (HWH-SAGR)
 - HARWICH FORMATION (HWH-SANDU)
 - LONDON CLAY FORMATION (LC-CLAY)
 - LEWES NODULAR CHALK FORMATION (LECH-CHLK)
 - LAMBETH GROUP (LMBE-SACL)
 - LAMBETH GROUP (LMBE-SANCL)
 - NEW PIT CHALK FORMATION (NPCH-CHLK)
 - SEAFORD CHALK FORMATION (SECK-CHLK)
 - THANET SAND FORMATION (TAB-SANDU)
 - NORMAL FAULT, INFERRED



ILLUSTRATIVE DESIGN

P02	S5	12-08-2016	POST CONSULTATION SAR ISSUE	MG	CC	JB
P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chkd	Apprv

Client **highways england**

Project **LOWER THAMES CROSSING**

Drawing title **Location C Geological Map - Bedrock Sheet 2 of 2**

Client: **Halcrow Hyder Joint Venture**
 Burderop Park
 Swindon, SN4 0QD
 Tel. +44(0)1793 812479

Project: **HA 540039-HHJ-GT-CZZZZZZZZZ-DR-GT-008**

Status: **S5** Revision: **P02**

Scale: **As Shown** Date: **09-08-2016**

Drawn By: **D Delgado**

Checked By: **C Cooper**

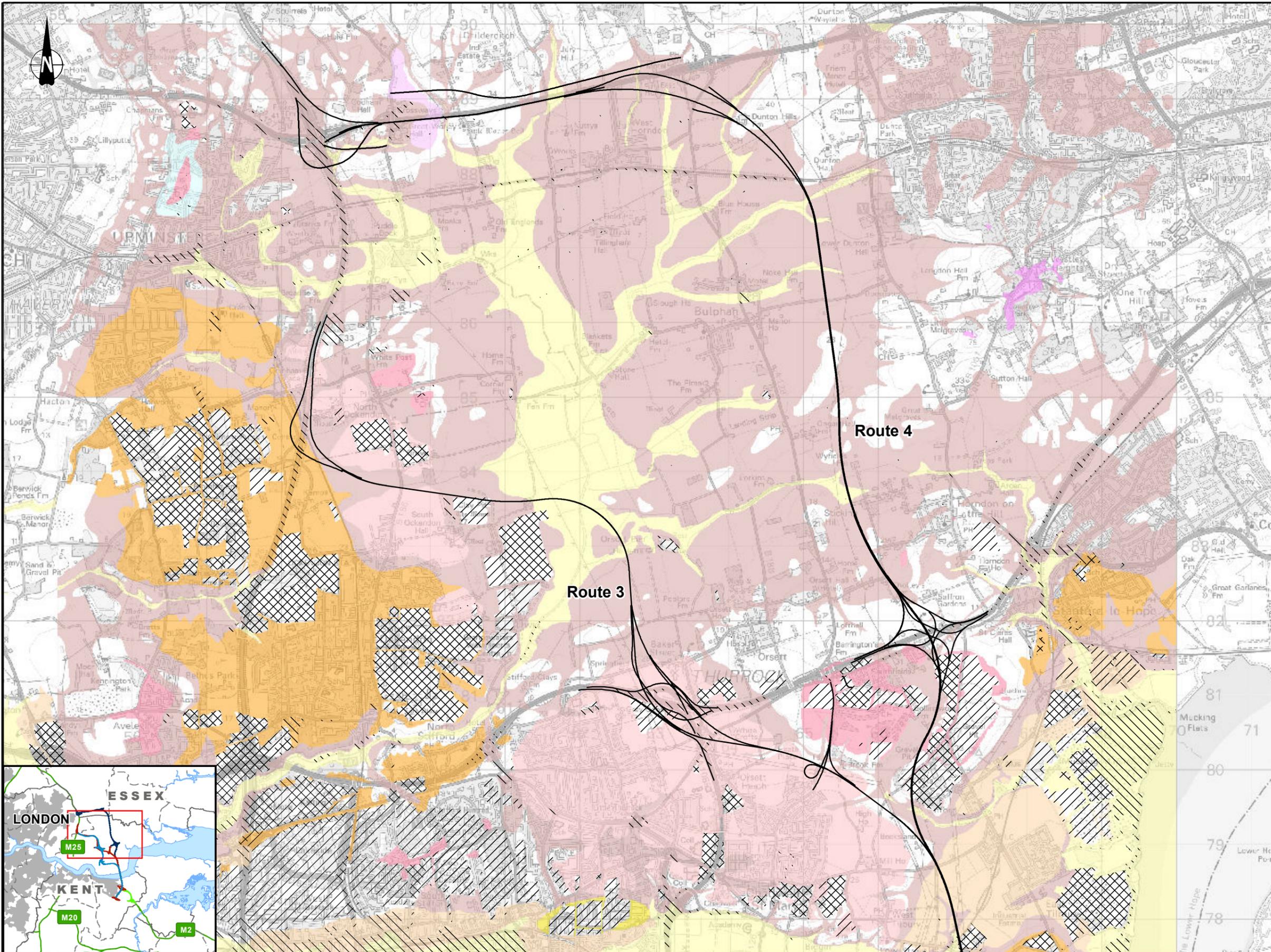
Approved By: **J Baple**

Project No. **HA 540039** | Originator **HHJ** | Original Size **A3**

Drawing number **HA540039-HHJ-GT-CZZZZZZZZZ-DR-GT-008**

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Client	highways england
Project	LOWER THAMES CROSSING
Drawing title	Location C Geological Map - Bedrock Sheet 2 of 2
Status	S5
Revision	P02
Scale	As Shown
Date	09-08-2016
Drawn By	D Delgado
Checked By	C Cooper
Approved By	J Baple
Project No.	HA 540039
Originator	HHJ
Original Size	A3
Drawing number	HA540039-HHJ-GT-CZZZZZZZZZ-DR-GT-008



- Location C**
- Drift**
- ALLUVIUM (ALV-Z)
 - BOYN HILL GRAVEL MEMBER (BHT-XSV)
 - BLACK PARK GRAVEL MEMBER (BPGR-XSV)
 - GLACIOFLUVIAL DEPOSITS (GFDU-XSV)
 - GLACIOLACUSTRINE DEPOSITS (GLLD-XSC)
 - HEAD (HEAD-C)
 - HEAD (HEAD-XVSZ)
 - ILFORD SILT MEMBER (ILSI-Z)
 - KEMPTON PARK GRAVEL FORMATION (KPGR-XSV)
 - LYNCH HILL GRAVEL MEMBER (LHGR-XSV)
 - RIVER TERRACE DEPOSITS (RTDU-XSV)
 - STANMORE GRAVEL FORMATION (STGR-XSV)
 - TILL (TILL-DMTN)
 - TAPLOW GRAVEL FORMATION (TPGR-XSV)
 - TIDAL RIVER OR CREEK DEPOSITS (TRD-Z)
 - MADE GROUND (MGR-ARTDP)
 - MADE GROUND (MGR-UKNOWN)
 - WORKED GROUND (WGR-UKNOWN)
 - WORKED GROUND (WGR-VOID)
 - INFILLED GROUND (WMGR-ARTDP)
 - INFILLED GROUND (WMGR-UKNOWN)



ILLUSTRATIVE
DESIGN

P02	S5	12-08-2016	POST CONSULTATION SAR ISSUE	MG	CC	JB
P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB

Rev Status Rev. Date Purpose of revision Drawn Chkd Apprv

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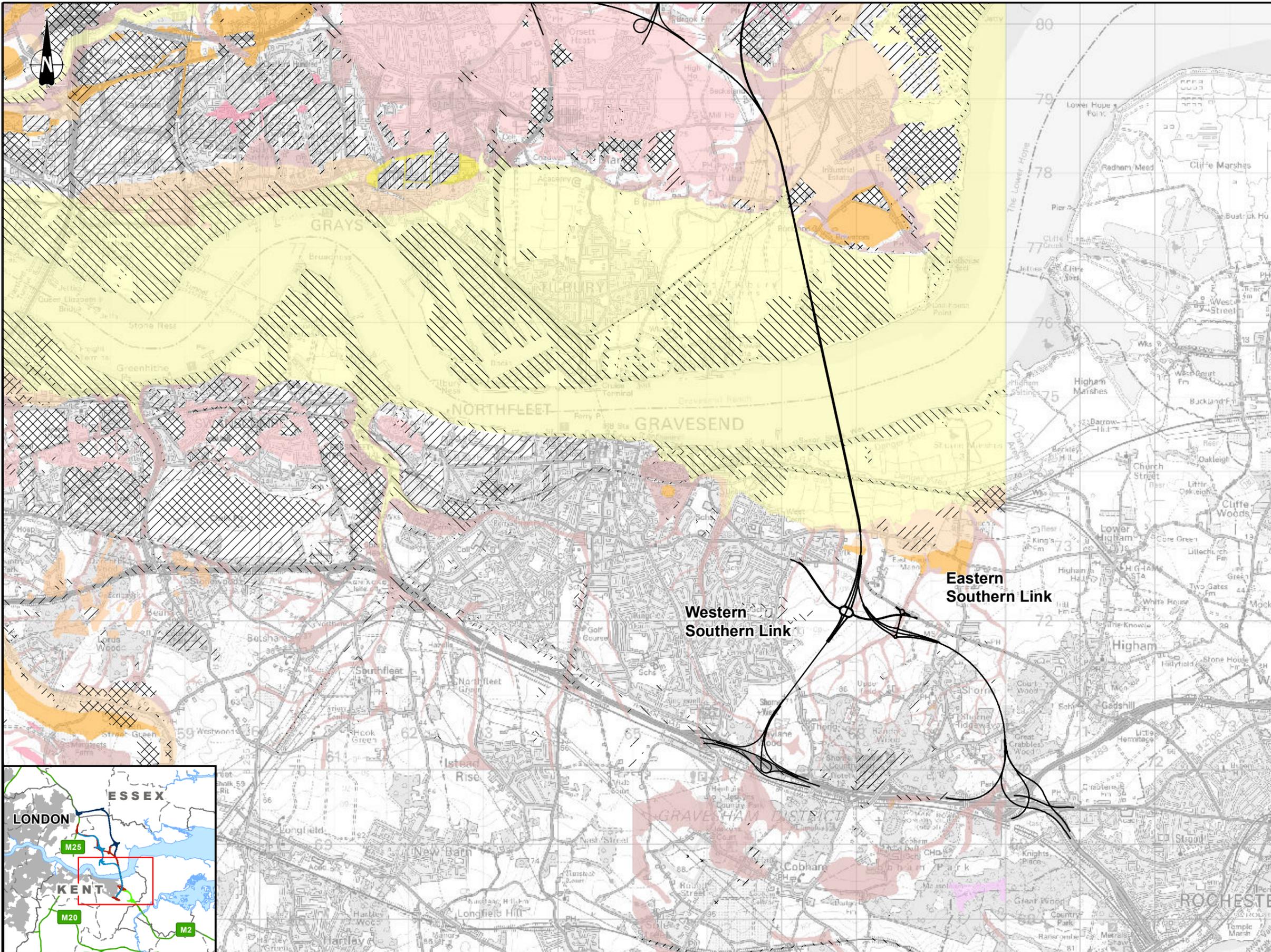
Client **highways england**

Halcrow Hyder Joint Venture
 Burderop Park
 Swindon, SN4 0QD
 Tel. +44(0)1793 812479

Project **LOWER THAMES CROSSING**

Drawing title **Location C
Geological Map - Drift
Sheet 1 of 2**

Status	S5	Revision	P02
Scale	As Shown	Date	09-08-2016
Drawn By	D Delgado	Checked By	C Cooper
Approved By	J Baple	Project No.	HA 540039
Project No.	HA 540039	Originator	HHJ
Drawing number	HA540039-HHJ-HGT-CZZZZZZZZ-DR-GT-005		
Original Size	A3		



- Location C**
- Drift**
- ALLUVIUM (ALV-Z)
 - BOYN HILL GRAVEL MEMBER (BHT-XSV)
 - BLACK PARK GRAVEL MEMBER (BPGR-XSV)
 - HEAD (HEAD-C)
 - HEAD (HEAD-DMTN)
 - HEAD (HEAD-V)
 - HEAD (HEAD-XSC)
 - HEAD (HEAD-XSV)
 - ILFORD SILT MEMBER (ILSI-Z)
 - KEMPTON PARK GRAVEL FORMATION (KPGR-XSV)
 - LYNCH HILL GRAVEL MEMBER (LHGR-XSV)
 - PEAT (PEAT-P)
 - RIVER TERRACE DEPOSITS (RTDU-XSV)
 - SAND AND GRAVEL OF UNKNOWN AGE (SGU-XSV)
 - TAPLOW GRAVEL FORMATION (TPGR-XSV)
 - TIDAL RIVER OR CREEK DEPOSITS (TRD-Z)
 - DISTURBED GROUND (DDGR-UKNOWN)
 - LANDSCAPED GROUND (LSGR-UKNOWN)
 - MADE GROUND (MGR-ARTDP)
 - MADE GROUND (MGR-UKNOWN)
 - WORKED GROUND (WGR-UKNOWN)
 - WORKED GROUND (WGR-VOID)
 - INFILLED GROUND (WMGR-ARTDP)
 - INFILLED GROUND (WMGR-UKNOWN)



**ILLUSTRATIVE
DESIGN**

P02	S5	12-08-2016	POST CONSULTATION SAR ISSUE	MG	CC	JB
P01	S5	18-01-2016	SAR ISSUE	DD	CC	JB

Rev | Status | Rev. Date | Purpose of revision | Drawn | Chkd | Apprv | Licence No. 2015/103 British Geological Survey © NERC. All rights reserved. © Crown copyright and database rights 2015 Ordnance Survey 100030649

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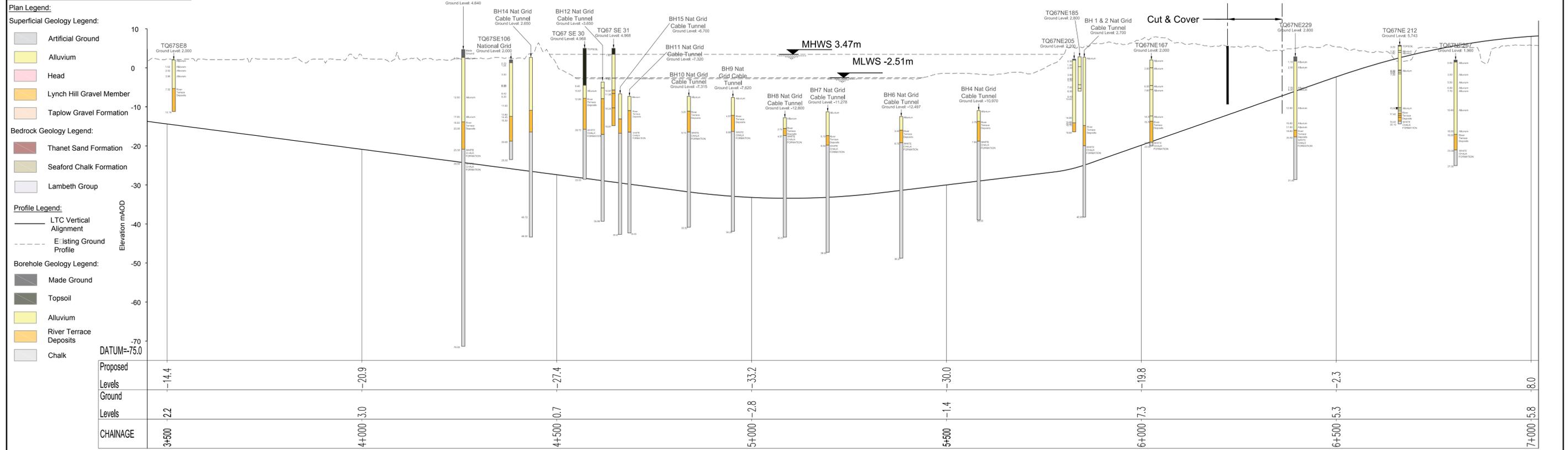
Project **LOWER THAMES CROSSING**

Drawing title **Location C
Geological Map - Drift
Sheet 2 of 2**

Status	S5	Revision	P02	
Scale	As Shown	Date	09-08-2016	
Drawn By	D Delgado			
Checked By	C Cooper			
Approved By	J Baple			
Project No.	HA PIN HA540039	Originator	HHJ	
Drawing number	HA540039-HHJ-HGT-CZZZZZZZZZ-DR-GT-006		Original Size	A3



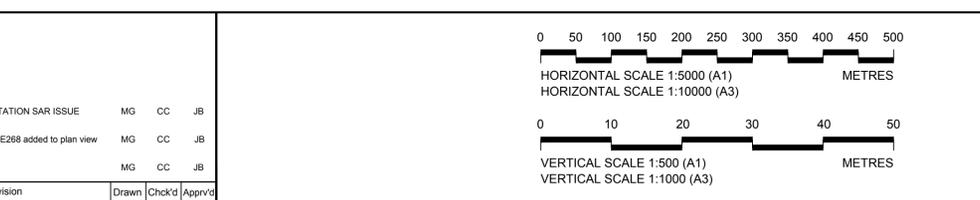
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- Plan Legend:**
- Artificial Ground
 - Alluvium
 - Head
 - Lynch Hill Gravel Member
 - Taplow Gravel Formation
- Bedrock Geology Legend:**
- Thanet Sand Formation
 - Seaford Chalk Formation
 - Lambeth Group
- Profile Legend:**
- LTC Vertical Alignment
 - Existing Ground Profile
- Borehole Geology Legend:**
- Made Ground
 - Topsoil
 - Alluvium
 - River Terrace Deposits
 - Chalk

Proposed Levels	-14.4	-20.9	-27.4	-33.2	-30.0	-19.8	-2.3	-8.0
Ground Levels	-2.2	-3.0	-0.7	-2.8	-1.4	-7.3	-5.3	-5.8
CHAINAGE	3+500	4+000	4+500	5+000	5+500	6+000	6+500	7+000

Rev	Status	Rev. Date	Purpose of revision	Drawn	Check'd	Appr'd
P03	S5	12.08.16	POST CONSULTATION SAR ISSUE	MG	CC	JB
P02	S5	04.07.16	Borehole TQ67NE268 added to plan view	MG	CC	JB
P01	S5	18.01.16	SAR Issue	MG	CC	JB



ILLUSTRATIVE DESIGN
 THE DESIGN SHOWN ON THESE DRAWINGS IS ILLUSTRATIVE AND MAY BE SUBJECT TO CHANGE IN LATER STAGES OF THE SCHEME DEVELOPMENT

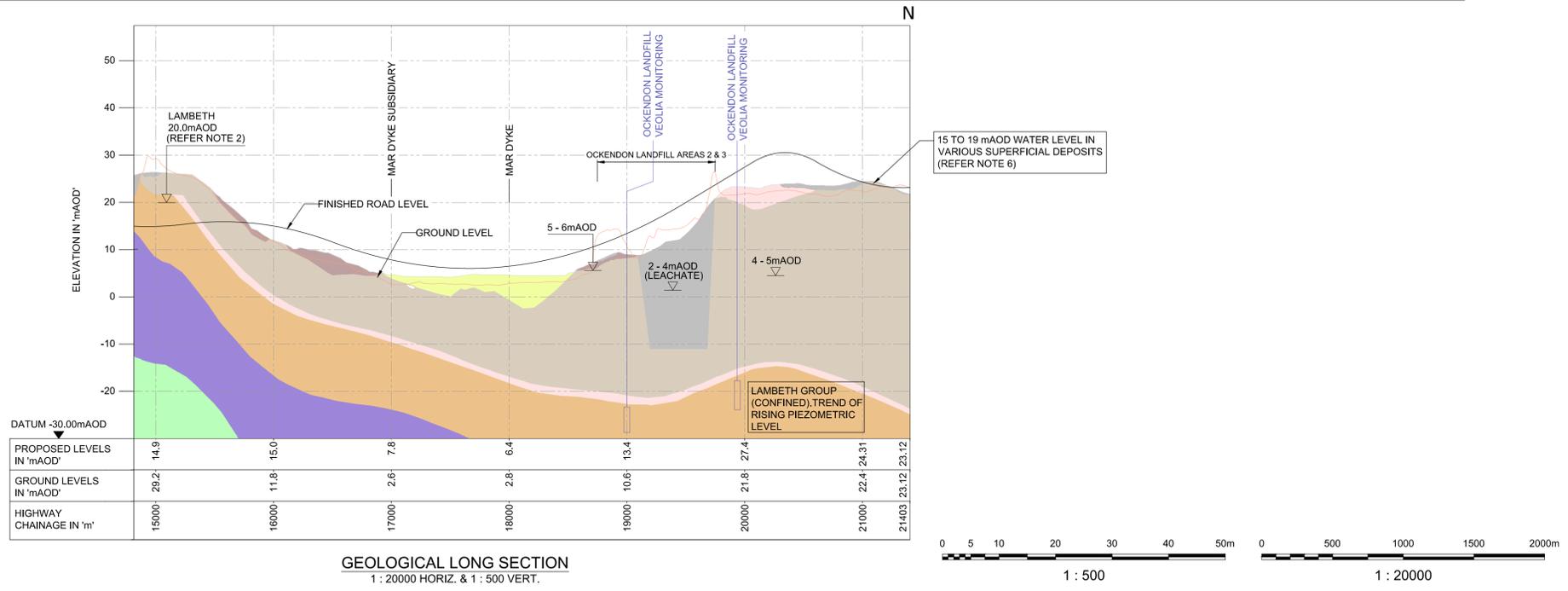
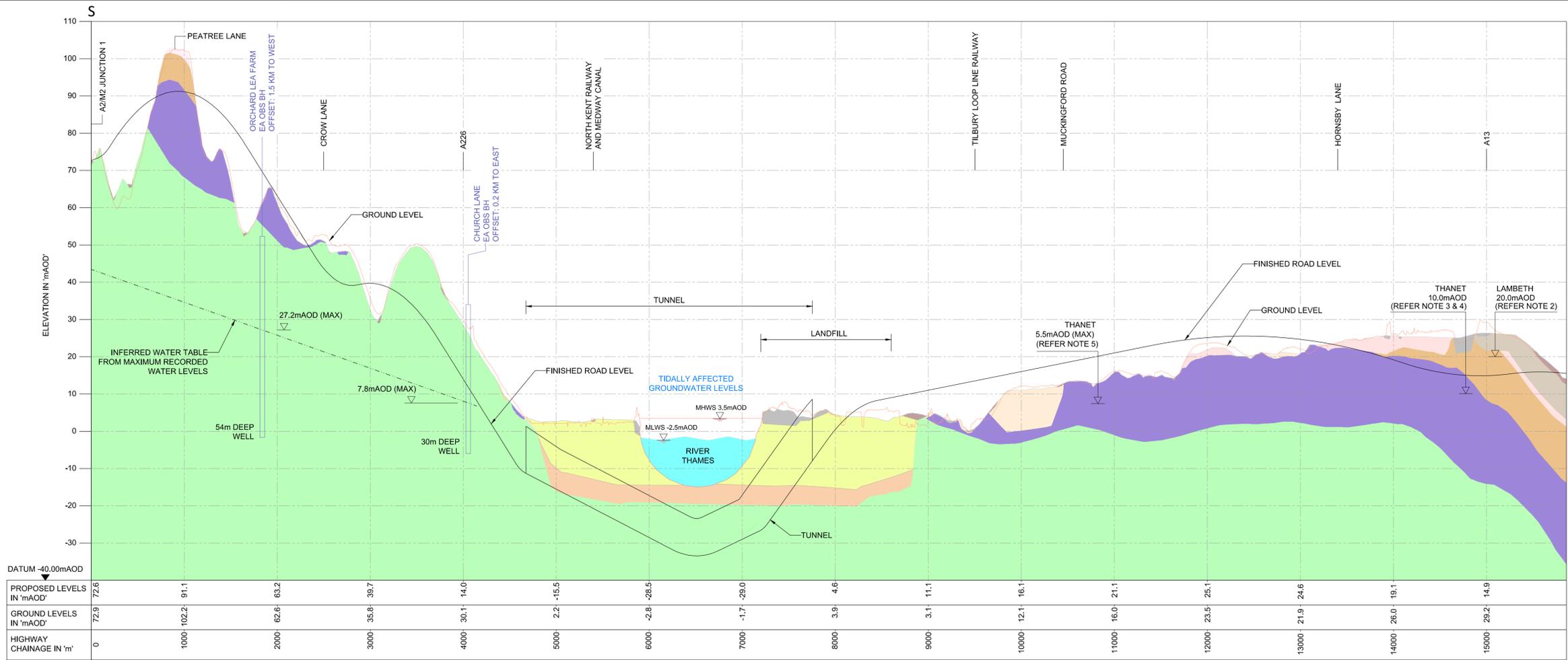
Client: **highways england**

Halcrow Hyder Joint Venture
 Burderop Park
 Swindon, SN4 0QD
 Tel. +44(0)1793 812479

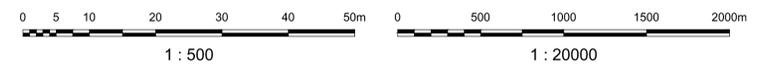
Project: **LOWER THAMES CROSSING**

Drawing title: **Route 3 and 4 River Crossing: Bored Tunnel Geological Long Section Sheet 1 of 1**

Status	S5	Revision	P03
Scale	As shown	Date	12.08.16
Drawn By	M.GAMLIN		
Checked By	C.COOPER		
Approved By	J.BAPLE		
Project No.	HA PIN HA540039	Originator	HHJ
Drawing number	HA540039-HHJ-HGT-CZZMCZZML-DR-GT-002		
Original Size	A1		



GEOLOGICAL LONG SECTION
1 : 20000 HORIZ. & 1 : 500 VERT.



ILLUSTRATIVE DESIGN

- NOTES:
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
 - BOREHOLE 378A (A13 GI MARCH TO JUNE 1973).
 - WATER STRIKE (A13 GI).
 - FAULT LINE INFERRED IN 1973 GROUND INVESTIGATION REPORT.
 - OLD TILBURY POWER STATION GROUNDWATER OBSTRUCTION BOREHOLE M5 (1988). BGS REFER TQ67NE226
 - M25 DBFO WIDENING GROUND INVESTIGATION REPORT (2011).

LEGEND:

PATTERN	DETAIL	PATTERN	DETAIL
[Pattern]	HEAD	[Pattern]	ALLUVIUM
[Pattern]	LONDON CLAY	[Pattern]	RIVER TERRACE DEPOSITS
[Pattern]	LAMBETH GROUP	[Pattern]	LYNCH HILL GRAVEL
[Pattern]	THANET FORMATION	[Pattern]	HARWICH FORMATION
[Pattern]	CHALK GROUP	[Pattern]	BOYN HILL GRAVEL
[Pattern]	TAPLOW GRAVEL	[Pattern]	WORKING GROUND

Client

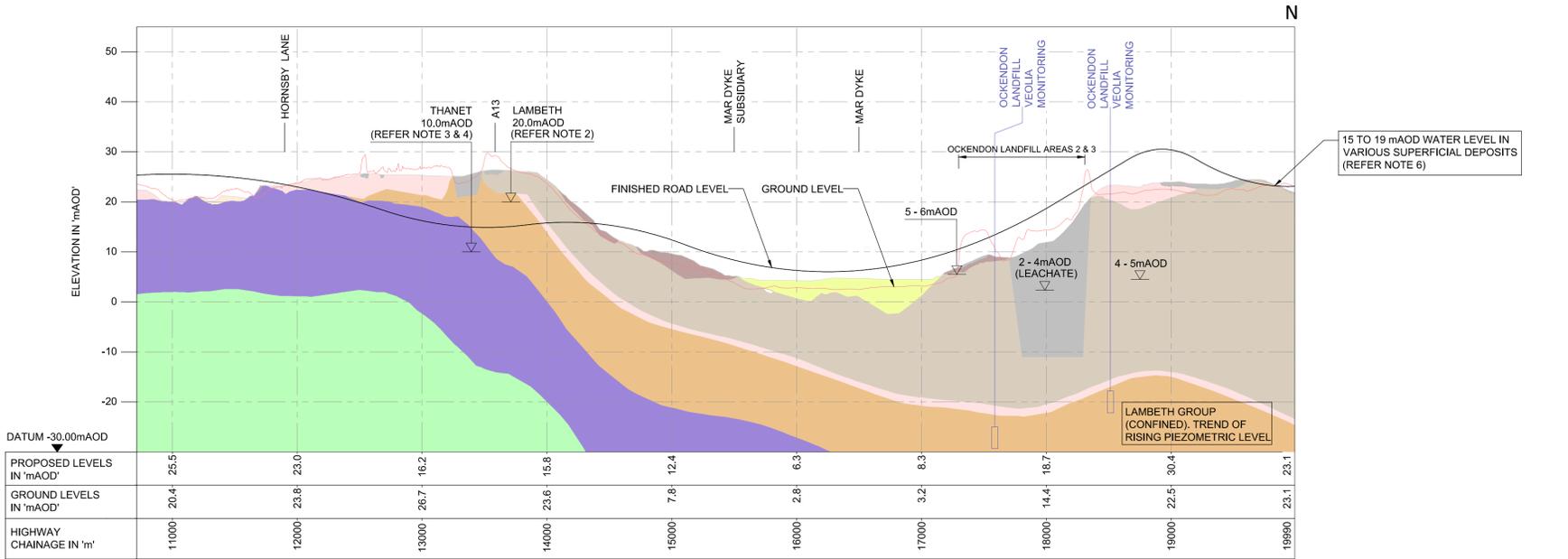
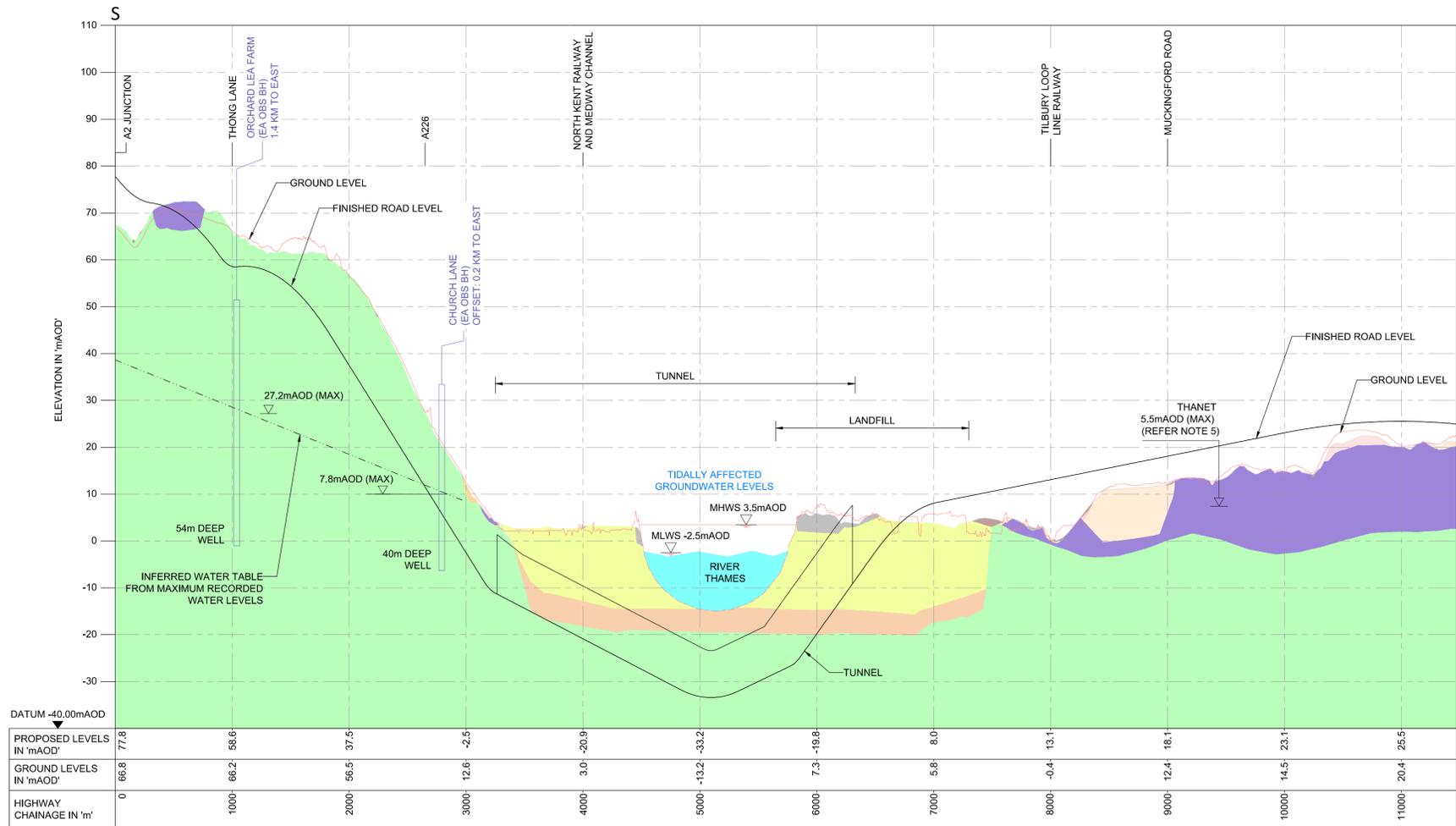
Burderop Park
Swindon, SN4 0DD
Tel. +44(0)1793 812479

Project LOWER THAMES CROSSING

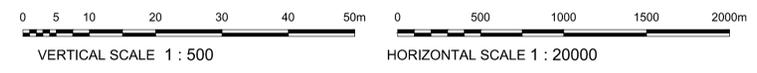
Drawing title Route 3 Eastern Southern Link Geological Long Section

Status	S5	Revision	P02
Scale	1 : 1200 @ A1	Date	12.08.16
Drawn By	Ashok A	Checked By	C Cooper
Approved By	J Baple	Project No.	HA PIN HA540039
Originator	HA540039	Original Size	A1
Drawing number	HA540039-HHJ-HGT-CD3MLZZZML-DR-GT-001		

P02	S5	12.08.16	Post Consultation SAR Issue	AA	CC	JB
P01	S4	15.02.16	First Issue	AA	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd



GEOLOGICAL LONG SECTION
1 : 20000 HORIZ. & 1 : 500 VERT.



ILLUSTRATIVE DESIGN

- NOTES:
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
 - BOREHOLE 378A (A13 GI) MARCH TO JUNE 1973.
 - WATER STRIKE (A13 GI).
 - FAULT LINE INFERRED IN 1973 GROUND INVESTIGATION REPORT.
 - OLD TILBURY POWER STATION GROUNDWATER OBSTRUCTION BOREHOLE M5 (1988). BGS REFER TQ67NE228
 - M25 DBFO WIDENING GROUND INVESTIGATION REPORT (2011).

LEGEND:		LEGEND:	
PATTERN	DETAIL	PATTERN	DETAIL
[Pattern]	HEAD	[Pattern]	ALLUVIUM
[Pattern]	LONDON CLAY	[Pattern]	RIVER TERRACE DEPOSITS
[Pattern]	LAMBETH GROUP	[Pattern]	LYNCH HILL GRAVEL
[Pattern]	THANET FORMATION	[Pattern]	HARWICH FORMATION
[Pattern]	CHALK GROUP	[Pattern]	BOYN HILL GRAVEL
[Pattern]	TAPLOW GRAVEL	[Pattern]	WORKING GROUND

Client

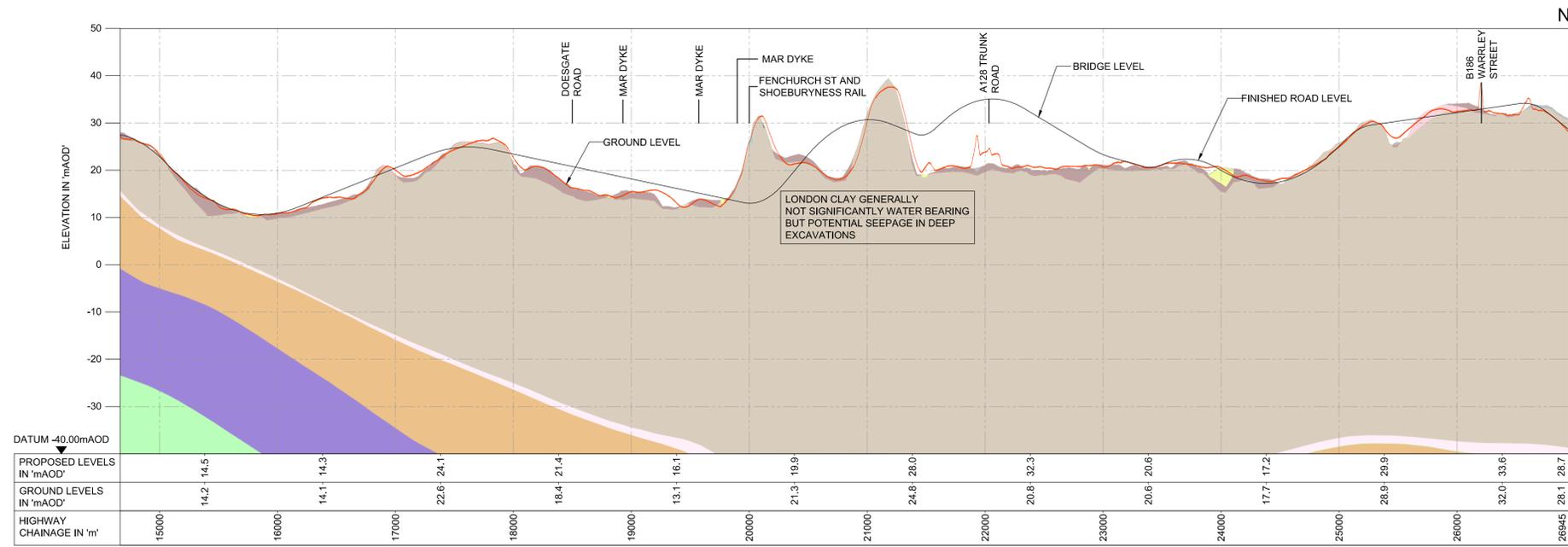
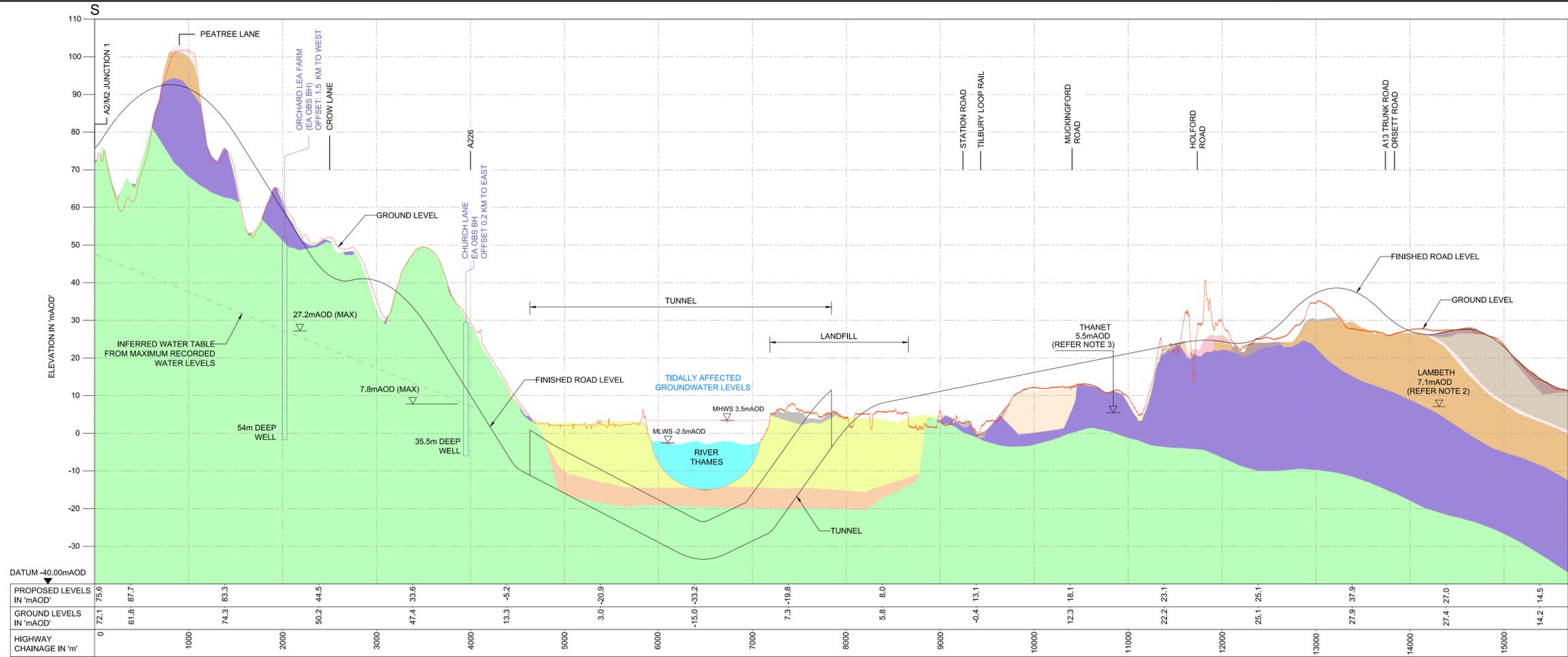
Halcrow Hyder Joint Venture
Burdorp Park
Swindon, SN4 0DD
Tel. +44(0)1793 812479

Project LOWER THAMES CROSSING

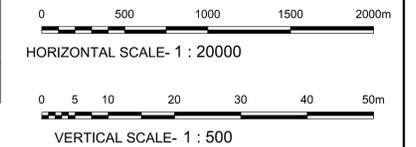
Drawing title Route 3 Western Southern Link Geological Long Section

Status	S5	Revision	P02
Scale	1 : 1200 @ A1	Date	12.08.16
Drawn By	Ashok A	Checked By	C Cooper
Approved By	J Baple	Project No.	HA PIN HA540039
Originator		Original Size	A1
Drawing number	HA540039-HHJ-HGT-CB1MLZZZML-DR-GT-002		

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd
P02	S5	12.08.16	Post Consultation SAR Issue	AA	CC	JB
P01	S4	16.02.16	First Issue	AA	CC	JB



GEOLOGICAL LONG SECTION
1 : 20000 HORIZ. & 1 : 500 VERT.



- NOTES:
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
 - BGS BOREHOLE TQ88SE60 MAY 1981.
 - OLD TILBURY POWER STATION GROUNDWATER OBSTRUCTION BOREHOLE M5 (1988). BGS REFER TQ67NE228.

PATTERN	DETAIL
▽	GROUNDWATER LEVEL (MAXIMUM RECORDED UNLESS OTHERWISE STATED)

PATTERN	DETAIL	PATTERN	DETAIL
[Pattern]	HEAD	[Pattern]	ALLUVIUM
[Pattern]	LONDON CLAY	[Pattern]	RIVER TERRACE DEPOSITS
[Pattern]	LAMBETH GROUP	[Pattern]	LYNCH HILL GRAVEL
[Pattern]	THANET FORMATION	[Pattern]	HARWICH FORMATION
[Pattern]	CHALK GROUP	[Pattern]	BOYN HILL GRAVEL
[Pattern]	TAPLOW GRAVEL	[Pattern]	WORKING GROUND

Client

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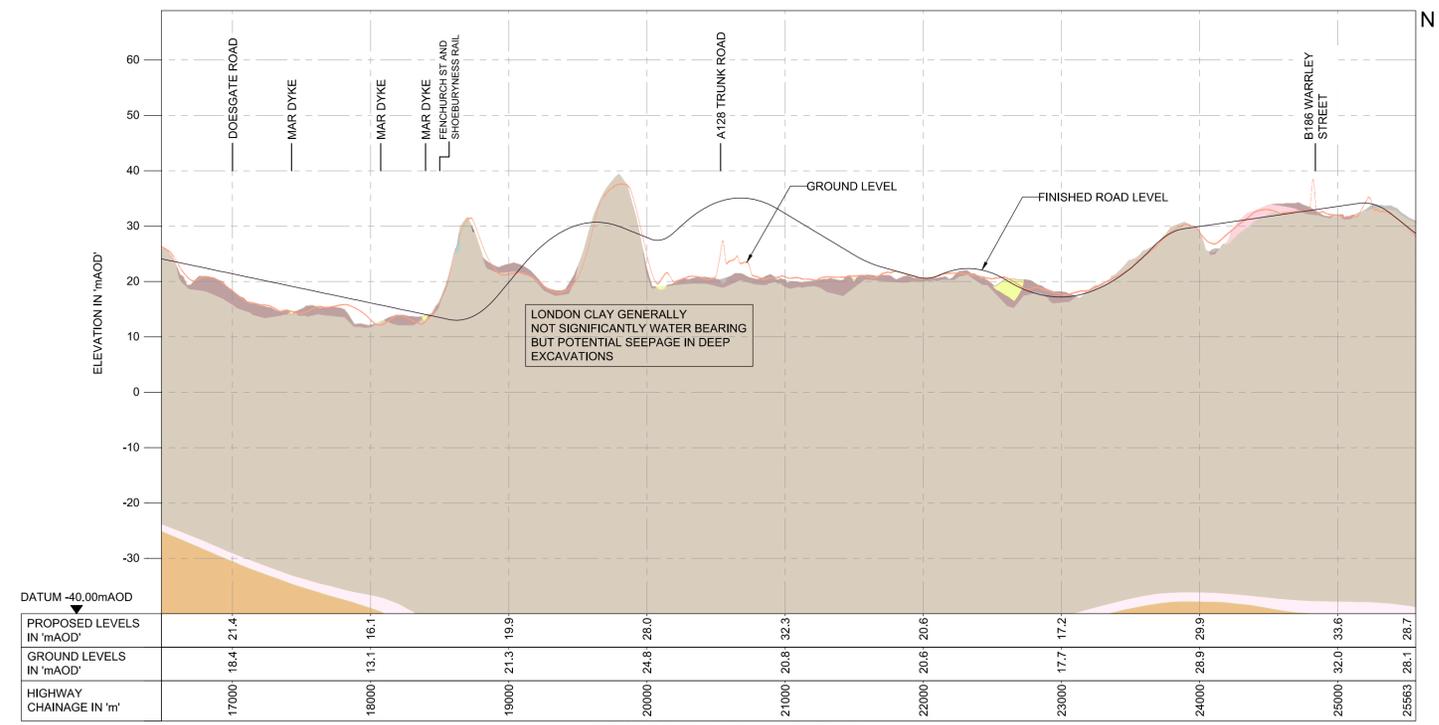
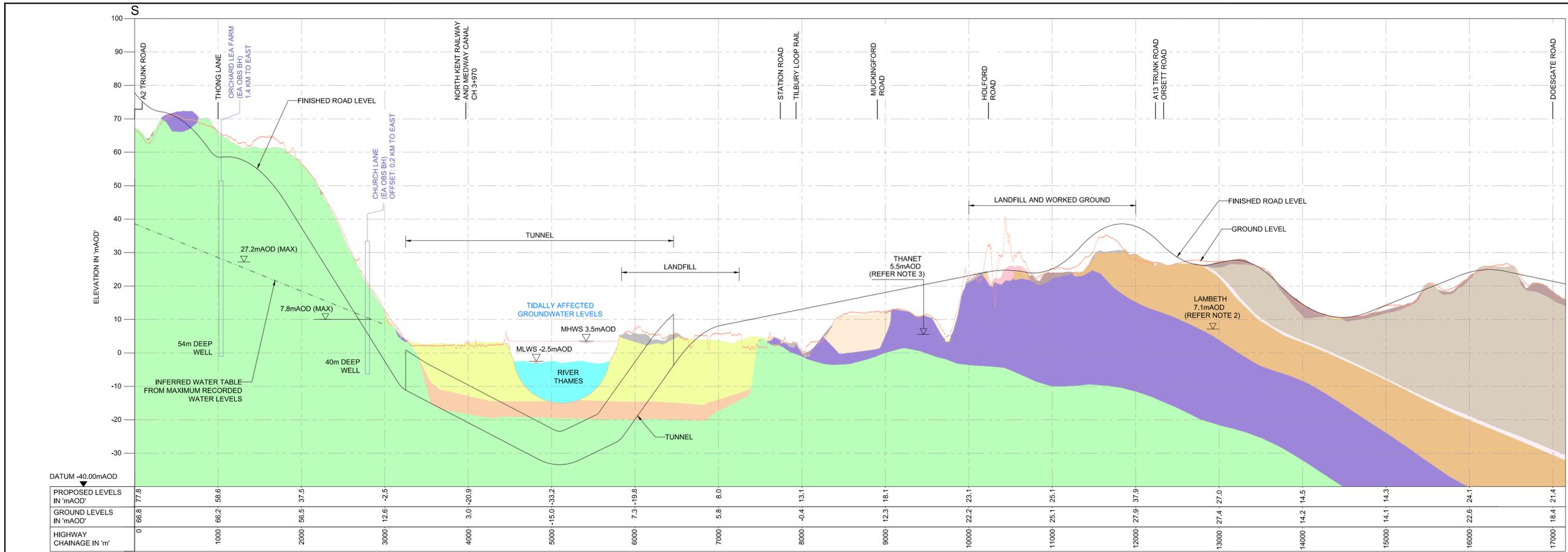
Project LOWER THAMES CROSSING

Drawing title
**Route 4
Eastern Southern Link
Geological Long Section**

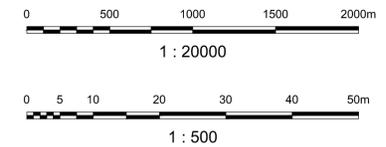
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Scale	1:1200 @ A1	Date	12.08.16
Drawn By	Ashok A		
Checked By	C Cooper		
Approved By	J Baple		
Project No.	HA PIN HA540039	Originator	
Drawing number	HA540039-HHJ-HGT-CD4MLZZML-DR-GT-001		

ILLUSTRATIVE DESIGN

Rev	Status	Rev. Date	Purpose of revision	Drawn	Check'd	Apprv'd
P02	S5	12.08.16	Post Consultation SAR Issue	AA	CC	JB
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GEOLOGICAL LONG SECTION
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NOTES:

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LEGEND:

PATTERN	DETAIL
	GROUNDWATER LEVEL (MAXIMUM RECORDED UNLESS OTHERWISE STATED)

LEGEND:

PATTERN	DETAIL	PATTERN	DETAIL
	HEAD		ALLUVIUM
	LONDON CLAY		RIVER TERRACE DEPOSITS
	LAMBETH GROUP		LYNCH HILL GRAVEL
	THANET FORMATION		HARWICH FORMATION
	CHALK GROUP		BOYN HILL GRAVEL
	TAPLOW GRAVEL		WORKING GROUND

Client

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Project

LOWER THAMES CROSSING

Drawing title

**Route 4
Western Southern Link
Geological Long Section**

Status	S5	Revision	P02
Scale	1:1200 @ A1	Date -	12.08.16
Drawn By	Ashok A		
Checked By	C Cooper		
Approved By	J Bayle		
Project No.	HA PIN HA540039	Originator	
Original Size			A1
HA540039-HHJ-HGT-CB1MLZZZML-DR-GT-003			

ILLUSTRATIVE DESIGN

P02	S5	12.08.16	Post Consultation SAR Issue	AA	CC	JB
P01	S4	16.02.16	First Issue	AA	CC	JB
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Apprv'd

Appendix 4.3 – Major Utilities Affected

Route 1 Major Utilities Affected

Route 3 Major Utilities Affected

Route 4 Major Utilities Affected

Eastern Southern Link Major Utilities Affected

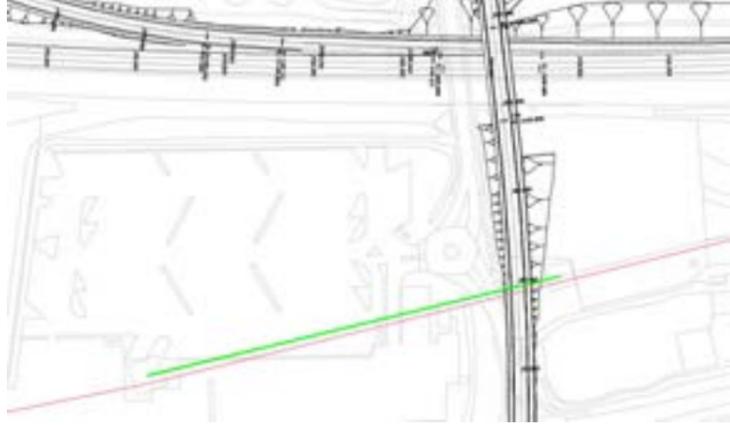
ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Overhead Cables						
R1-OH03	3525	2 spans, 138m & 213m	<p>Overhead conductors crossing the A282 roughly perpendicular to the line of the highway, continuing over the southern roundabout of Littlebrook interchange.</p> <p>Proposed widening and reconfiguration of A282 and southern Littlebrook Interchange roundabout anticipated to be at or near existing ground levels, requiring confirmation of safe clearance envelopes for both construction and operational phases.</p> <p>Presence of buried cables anticipated to north of terminal tower, passing beneath line of proposed northbound on slip.</p> <p>On slip is anticipated to be at or above existing ground.</p> <p>Data Source: OS Landline & Aerial Photography. Asset owner (UKTC) enquiries ongoing at time of writing.</p>	BR		<p>Positive identification of line and level required to inform onward design development - Survey&sag/sway calculations and required safe clearance envelope required from Asset Owner.</p> <p>Positive identification of line and level of buried services required to inform onward design development - GPR/Trial pits.</p> <p>Proposed Lighting, signing and surface ancillary infrastructure to be designed/located to avoid impinging upon safe clearance envelopes of overhead conductors. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting buried services.</p> <p>Protection of buried services to be determined in consultation with the asset owner. Construction phasing and site control to comply with asset owner's requirements.</p>
R1-OH04	3475	2 spans, 121m & 209m	<p>Overhead conductors crossing the A282 roughly perpendicular to the line of the highway, continuing over the southern roundabout of Littlebrook interchange.</p> <p>Proposed widening and reconfiguration of A282 anticipated to be at or near existing ground levels, requiring confirmation of safe clearance envelopes for both construction and operational phases.</p> <p>Proposed realignment southern Littlebrook Interchange roundabout may incur a reduction in headroom of upto 650mm.</p> <p>Presence of buried cables anticipated to north of terminal tower, passing beneath line of proposed northbound on slip.</p> <p>On slip is anticipated to be at or above existing ground.</p> <p>Data Source: OS Landline & Aerial Photography. Asset owner (UKTC) enquiries ongoing at time of writing.</p>	BR		<p>Positive identification of line and level required to inform onward design development - Survey&sag/sway calculations and required safe clearance envelope required from Asset Owner.</p> <p>Positive identification of line and level of buried services required to inform onward design development - GPR/Trial pits.</p> <p>Proposed Lighting, signing and surface ancillary infrastructure to be designed/located to avoid impinging upon safe clearance envelopes of overhead conductors. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting buried services.</p> <p>Protection of buried services to be determined in consultation with the asset owner.</p> <p>Should it be required, feasibility of raising the height of the intermediate tower to increase headroom at the southern Littlebrook Interchange roundabout to be investigated in consultation with the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
R1-OH05	4250	dual lines, 2 spans, 303&325m and 285&315m, 4 towers.	<p>National Grid overheads transverse across the A282 at the northbound approach viaduct to the Proposed Bridge crossing (250m north from the end of the proposed northbound Junction 1a on slip).</p> <p>Prescribed clearance to the Thames Navigable channel and limitations on available longitudinal gradient (4%) places the proposed approach viaduct at conductor level with prospect of direct clash. Diversion will be required.</p> <p>Service data source: National Grid As-built records.</p>	BR		<p>Engagement and involvement of asset owner (National Grid) to be sought.</p> <p>Diversion design and costing to be determined by asset owner (National Grid). Diversion route (TBC) to take due cognisance of National Grid's headroom requirements from TS43-8 tbl 6.1) and preferences for lateral clearance between relocated towers and the proposed highway. Existing towers affected: YL022 to YL0023A and YL0022 to YL023B.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
R1-OH16	7875	single span, 235m	<p>Proposed highway widening and partial realignment of existing A282 and National Grid High voltage overhead conductors intersect at a skew angle. Highway alignment changes anticipated to be predominantly at or near existing ground level, with potential for marginal reduction in clearance (c.200-300mm) where carriageway is raised for super elevation. Span affected:ZR026 to ZR027 Existing clearance c.17.3m. Anticipated clearance c.17.0 Data Source: National Grid 3D as-built records</p>	BR		<p>Engagement, headroom requirements and approval of asset owner (National Grid) to be sought. Highway alignment design and ancillary feature development to take due cognisance of National Grid's headroom requirements from TS43-8 tbl 6.1) and preferences for lateral clearance between relocated towers and the proposed highway. Diversion currently considered to unlikely. Potential exists for re-tensioning of tower height increase. However, initial estimates of clearances to proposed highway exceed the most onerous requirements of TS43-8.</p>
R1-OP02	3500	TBC	<p>Sub-surface Oil Pipeline(s) crossing the A282 roughly perpendicular to the carriageways. Existing depth unknown. Data Source: Linesearch. Supplied with indicated 100foot corridor - location within corridor is not definite. Proposed Northbound On slip crosses line of twin pipelines at or above existing ground level. Widening of southbound off-slip crosses the line of pipelines. Possible decrease in cover depth if pipelines deviate from midline of supplied 10 foot wide corridor information. Minor amendments to Littlebrook Interchange roundabouts at or above existing ground.</p>	BR		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Structure and foundation design for new bridges in the vicinity to be mindful of possible clash and/or sub-surface load distribution. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline. Engagement and approval of asset owner (Esso) to be sought. Protection works and/or diversion to be implemented on the advice of the asset owner. Construction phasing and site control to comply with asset owner's requirements.</p>
R1-OH17	8150	single span, 210m	<p>Proposed highway widening and partial realignment of existing A282 (and slips) and National Grid High voltage overhead conductors intersect approximately perpendicular to each other.. Highway alignment changes anticipated to be predominantly at or near existing ground level, with potential for marginal reduction in clearance (c.200-300mm) where carriageway is raised for super elevation. Span affected:ZBA012 to ZBA013 Anticipated clearance c.20.00m Data Source: National Grid 3D as-built records</p>	BR		<p>Engagement, headroom requirements and approval of asset owner (National Grid) to be sought. Highway alignment design and ancillary feature development to take due cognisance of National Grid's headroom requirements from TS43-8 tbl 6.1) and preferences for lateral clearance between relocated towers and the proposed highway. Diversion currently considered to unlikely. Potential exists for re-tensioning of tower height increase. However, initial estimates of clearances to proposed highway exceed the most onerous requirements of TS43-8.</p>

ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
R1-OH18	A13 Eastbound ch450	single span, 240m	<p>Proposed realignment of existing B186 Pilgrims Lane and National Grid High voltage overhead conductors intersect approximately perpendicular to each other..</p> <p>Highway alignment changes anticipated to be predominantly at or near existing highway level, with potential for marginal reduction in clearance (c.100-200mm) where carriageway is raised for super elevation.</p> <p>Span affected: YYJ099 to YYJ100</p> <p>Anticipated clearance c.30.00+m</p> <p>Due to existing topography, proposed highway is on embankment (c.2.5m height) the toe of which is found in close proximity with YYJ100 foundation footprint. Lateral load transferral is possible.</p> <p>Data Source: National Grid 3D as-built records</p>	BR		<p>Engagement, headroom requirements and approval of asset owner (National Grid) to be sought.</p> <p>Highway alignment design and ancillary feature development to take due cognisance of National Grid's headroom requirements from TS43-8 tbl 6.1) and preferences for lateral clearance between relocated towers and the proposed highway.</p> <p>Diversion currently considered to unlikely. Potential exists for re-tensioning of tower height increase. However, initial estimates of clearances to proposed highway exceed the most onerous requirements of TS43-8.</p> <p>Diversion or tower modification is considered unlikely. Potential exists for earthworks steepening or a localised low retaining structure to limit highway footprint encroachment towards tower base.</p>

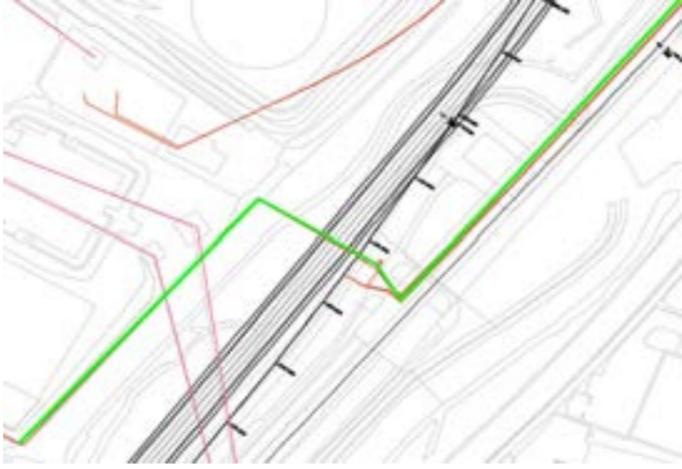
ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Gas Mains						
R1-GP01	2665	8m (to west) 8m (to east)	Sub-surface medium pressure gas pipeline crossing beneath existing A282 on approximate line of Bow Arrow Lane south footway. Widening to northbound and southbound A282 increases extent and depth of cover to east (approx. 1m increased cover depth) and west (approx. 2m increased cover depth). Existing depth of cover unknown. Data source: National Grid	BR		Positive identification of line and level required to inform onward design development - GPR/Trial pits. Structure and foundation design for new bridges in the vicinity to be mindful of possible clash and/or sub-surface load distribution. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline. Engagement and approval of asset owner (National Grid) to be sought. Protection works and/or diversion to be implemented on the advice of the asset owner. Construction phasing and site control to comply with asset owner's requirements.
Oil Pipeline						
R1-OP02	3500	TBC	Sub-surface Oil Pipeline(s) crossing the A282 roughly perpendicular to the carriageways. Existing depth unknown. Data Source: Linesearch. Supplied with indicated 100foot corridor - location within corridor is not definite. Proposed Northbound On slip crosses line of twin pipelines at or above existing ground level. Widening of southbound off-slip crosses the line of pipelines. Possible decrease in cover depth if pipelines deviate from midline of supplied 10 foot wide corridor information. Minor amendments to Littlebrook Interchange roundabouts at or above existing ground.	BR		Positive identification of line and level required to inform onward design development - GPR/Trial pits. Structure and foundation design for new bridges in the vicinity to be mindful of possible clash and/or sub-surface load distribution. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline. Engagement and approval of asset owner (Esso) to be sought. Protection works and/or diversion to be implemented on the advice of the asset owner. Construction phasing and site control to comply with asset owner's requirements.

ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Cable Tunnel						
R1-UG07	4500-4700	200m (parallel)	<p>Proposed Highway alignments to both Bridge and Tunnel variants run parallel to deep National Grid Cable Tunnel beneath the Thames. The proposed highway alignments have been positioned to maintain a minimum lateral clearances of 20m for the Bridge and 25m for the Tunnel options.</p> <p>There is potential for sub-surface load and/or vibration transmission.</p> <p>NB - The attached illustration for the tunnel option indicates earthworks cutting extents which are to be replaced by cut&cover and bored tunnel techniques. The earthworks extents shown are <i>not</i> the proposed solution, but merely indicate where the proposed highway is below ground.</p>	BR		<p>Engagement and approval of asset owner (National Grid) to be sought. Development of structural solutions for bridge and tunnel to take due cognisance of National Grid advice. Diversion requirement is not anticipated at this time.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
R1-UG14	6180	50	<p>Proposed footprint of northern approach viaduct intersects with the line of National Grid's Thames Crossing Cable Tunnel. Tunnel is expected to be encountered at considerable depth below existing ground. Potential clash or influence by bridge foundations.</p> <p>Data Source: National Grid As-built information</p>	BR		<p>Engagement and involvement of asset owner (National Grid) to be sought. Development of structural solutions for bridge to take due cognisance of National Grid advice. If bridge pier spacing and foundation type and method of construction is developed to the asset owner's approval, diversion requirement is considered to be unlikely and technically unfeasible.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Underground Electric Cable						
R1-UG08	4385	110m	<p>Sub surface National Grid conductors (issuing from the existing western tunnel bore) and approach viaduct for bridge crossing, intersect roughly perpendicular to each other.</p> <p>The proposed highway is on Viaduct approximately 30m above existing ground at this location.</p> <p>Data Source: Linesearch</p>	BR		<p>Engagement and involvement of asset owner (National Grid) to be sought. Development of structural solutions for bridge and tunnel to take due cognisance of National Grid advice. Diversion requirement is not anticipated at this time. Likelihood of cable status (possible redundancy) to be explored fully. Anecdotally thought to have been replaced in part by the National Grid Thames cable tunnel. Construction phasing and site control to comply with asset owner's requirements.</p>
R1-UG10	5800-5900	120m	<p>Sub-surface high voltage National Grid cables found within 10m of northern approach viaduct footprint with partial encroachment beneath.</p> <p>Anecdotally thought to be redundant sub-surface of element of National Grid's Thames crossing subsequently diverted away from the line of HS1 into the new Thames Cable Tunnel. If residual function and asset value is confirmed, proximity with viaduct foundations is possible with associated risk of sub-surface load or vibration transmission.</p>	BR		<p>Engagement and involvement of asset owner (National Grid) to be sought. Development of diversion solutions to be developed in consultation with the asset owner. Likelihood of cable status (possible redundancy) to be explored fully. Anecdotally thought to have been replaced in part by the National Grid Thames cable tunnel. If found to be functional, diversion is unlikely, protection works more likely. Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 1 MAJOR UTILITIES AFFECTED

REF	SCHEME REF CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
R1-UG11	5800	150	<p>Sub-surface high voltage National Grid cable route found within 25m of northern approach viaduct alignment. Route and highway footprint do not directly clash. However, possible lateral load or vibration transfer may occur.</p> <p>Data Source: Linesearch</p>	BR		<p>Engagement and approval of asset owner (National Grid) to be sought. Development of structural solutions for bridge and approach viaduct to take due cogniscence of National Grid advice. Diversion requirement is not anticipated at this time.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Overhead Cables						
C2-OH01	0+000 A2 Junction	415	<p>Overhead Cable crossing roughly perpendicularly to A2 Realignment and A2 eastbound to LTC Slip road, continuing parallel to the LTC.</p> <p>Pylon AYN049A affected by A2 Realignment.</p> <p>Cable clearances to proposed levels: OHC z1=82.0m, z2= 80.6m, z3=77.5m LTC z1=69.3m, z2=72.9m, z3=69.8m</p>	BT		<p>Subject to lateral clearance requirements: - No action required - 415m underground diversion and pylon AYN049A removal.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Preferences for lateral clearance between towers and the proposed highway to be confirmed to determine if pylon AYN049A needs to be relocated/removed. Construction phasing and site control to comply with asset owner's requirements.</p>
C2-OH04	6+340	224	<p>Overhead Cable crossing perpendicularly over the LTC mainline, which is in embankment at this point.</p> <p>Cable clearances to proposed levels: OHC z=6.5m LTC z=13.7m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>
C2-OH05	9+610	430	<p>Overhead Cable crossing over the LTC mainline, which is in embankment at this point.</p> <p>Cable clearances to proposed levels: Cable z=5.35m LTC z=13.9m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C2-OH06	10+140	284	Overhead Cable crossing perpendicularly over the LTC mainline, which is in embankment at this point. Pylons affected by the LTC earthworks. Cable clearances to proposed levels not available.	BT		Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements. Cable clearances not available. Assume 284m underground diversion .
C2-OH07	11+210	301	Overhead Cable crossing over the LTC mainline, which is in embankment at this point. Cable clearances to proposed levels: Cable z=21.0m LTC z =22.0m	BT		Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements. 301m underground diversion .
C2-OH08	11+260	303	Overhead Cable crossing perpendicularly over the LTC mainline, which is in embankment at this point. Cable clearances to proposed levels: Cable z=19.7m LTC z =22.4m	BT		Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements. 303m underground diversion .
C2-OH09	12+010	740	Overhead Cable crossing over the LTC mainline, which is in embankment at this point, and over the LTC to Brentwood road slip in cutting. Cable clearances to proposed levels: Cable z1=27.1m, z2=33.3m, z3=37.5m LTC z1=24.2m, z2=17.7m, z3=23.7m	BT		Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements. 500m underground diversion under LTC mainline. Clearances of existing cables adequate over junction slip road.

ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C2-OH10	12+110	739	<p>Overhead Cable crossing over the LTC mainline, which is in embankment at this point, and over the LTC to Brentwood road slip in cutting.</p> <p>Cable clearances to proposed levels: Cable information missing, assume similar layout to C2-OH09</p>	BT		<p>Assuming similar layout to that of C2-OH09: - 425m underground diversion under LTC mainline. - Clearances of existing cables adequate over junction slip road.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.</p>
C2-OH11	15+410	671	<p>Overhead Cable crossing over the LTC mainline in cutting, over the A13 eastbound to LTC southbound slip at the ground level, over the A13 westbound to LTC northbound slip in embankment, and over the A1089 to A13 westbound slip in cutting.</p> <p>Cable clearances to proposed levels: OHC z=29.1m LTC z=15.15m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>
C2-OH12	18+260	354	<p>Overhead Cable crossing perpendicularly over the LTC mainline, which is in embankment at this point.</p> <p>Cable clearances to proposed levels: OHC z=7.5m LTC z=10.1m</p>	BT		<p>349m underground diversion.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements do not comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>
C2-OH13	M25 Junction	269	<p>Overhead Cable crossing over the M25 mainline and over M25 - LTC Slip roads in embankment.</p>	BT		<p>Cable clearances not available. Assume raising pylons to achieve required clearance and divert 268 meters of overhead line.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements do not comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>

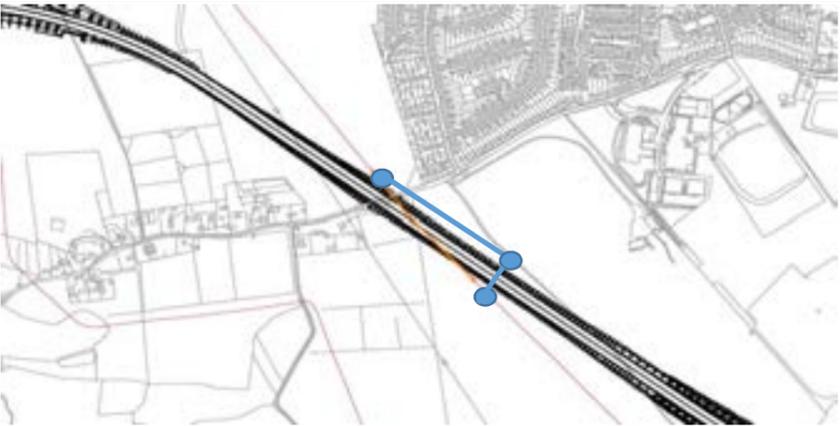
ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C2-OH14	A226 Realignment	665	<p>Overhead Cable crossing perpendicularly to A226 Realignment, which at that point is at ground level. Pylon AYN041 located in the new alignment of the A226.</p> <p>Cable clearances to proposed levels: OHC z=44.5m LTC z=32.0m</p>	BT		<p>Subject to lateral clearance requirements: - No action required - 665m underground diversion and pylon AYN041 removal.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Preferences for lateral clearance between towers and the proposed highway to be confirmed to determine if pylon AYN041 needs to be relocated/removed. Construction phasing and site control to comply with asset owner's requirements.</p>

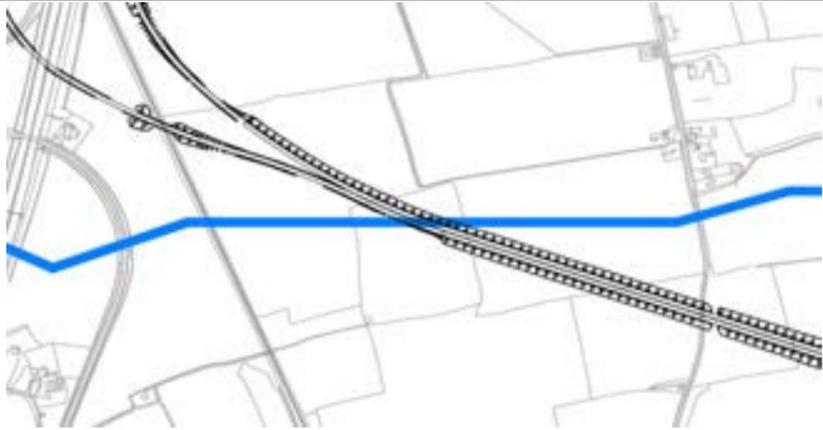
ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Gas mains						
C2-GM01	-	125	Gas feeder affected by A2 and LTC Slip roads. Crossing under the new link road connecting Hever Ct Rd to Brewers road junction in cutting, under the A2 mainline at ground level, and under the A2 eastbound to LTC in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C2-GM02	-	182	Gas feeder affected by A2 and LTC Slip roads. Crossing under the new link road connecting Hever Ct Rd to Brewers road junction in cutting, under the A2 mainline at ground level, and under the A2 eastbound to LTC in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C2-GM03	-	430	Gas feeder affected by A2 and LTC Slip roads. Crossing under the A2 eastbound to LTC slip road, under the LTC mainline, and under the LTC to A2 eastbound slip, all of them in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

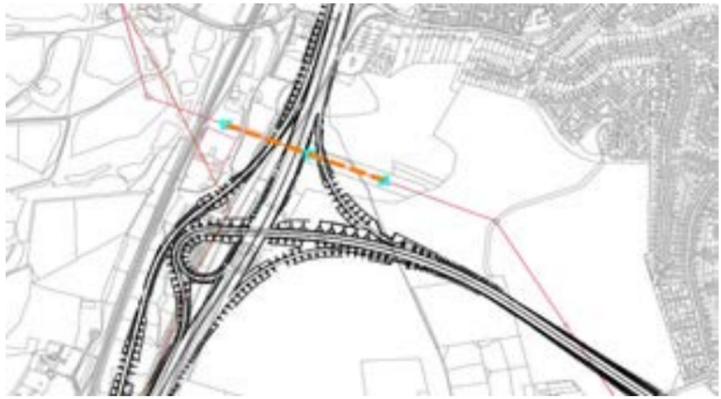
ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C2-GM04	1+000	298	Gas feeder crossing under the LTC Mainline in cutting	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Pipe likely to be affected, in which case a suitable diversion will need to be proposed and the pipe level lowered under the mainline level.</p> <p>Subject to Gas Feeder level and required clearance:</p> <ul style="list-style-type: none"> - None - 380m underground diversion under LTC level <p>Engagement and approval of asset owner (National Grid) to be sought. Protection works and/or diversion to be implemented on the advice of the asset owner.</p>

ROUTE 3 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C2-OP01	20+910		Barking Power Station gas main crossing under the LTC mainline in embankment.	BT	 <p>The location plan is a technical drawing showing a proposed blue line (LTC mainline) crossing over an existing gas main (indicated by a dashed line with a cross-hatch pattern). The gas main is located in an embankment. The drawing shows the relative positions of the mainlines and the embankment structure.</p>	<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Overhead cables						
C9-OH01	-	415	<p>Overhead Cable crossing roughly perpendicularly to A2 Realignment and A2 eastbound to LTC Slip road, continuing parallel to the LTC. Pylon AYN049A affected by A2 Realignment.</p> <p>Cable clearances to proposed levels: OHC z1=82.0m, z2= 80.6m, z3=77.5m LTC z1=69.3m, z2=72.9m, z3=69.8m</p>	BT		<p>Subject to lateral clearance requirements: - No action required - 415m underground diversion and pylon AYN049A removal.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Preferences for lateral clearance between towers and the proposed highway to be confirmed to determine if pylon AYN049A needs to be relocated/removed. Construction phasing and site control to comply with asset owner's requirements.</p>
C9-OH04	9+110	222	<p>Overhead Cable crossing perpendicularly over the LTC mainline, which is in embankment at this point.</p> <p>Cable clearances to proposed levels: OHC z=6.5m LTC z=13.7m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>
C9-OH05	9+410	428	<p>Overhead Cable crossing over the LTC mainline, which is in embankment at this point.</p> <p>Cable clearances to proposed levels: Cable z=5.35m LTC z=13.9m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.</p>

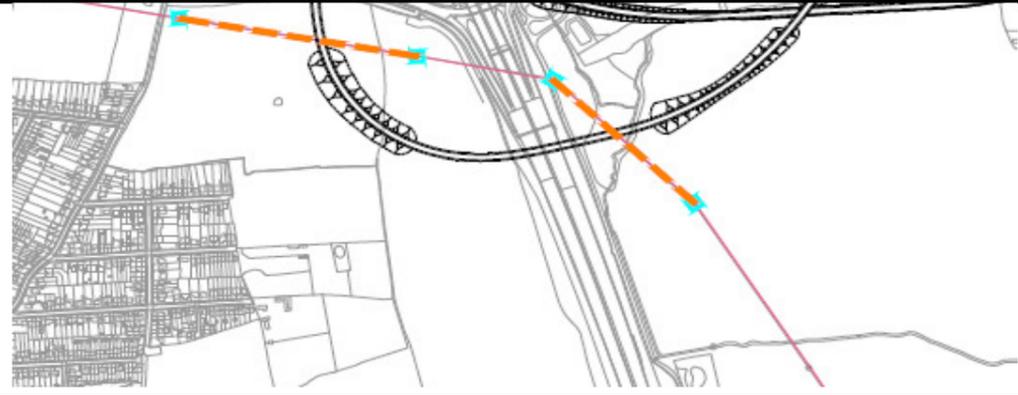
ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C9-OH06	10+310	285	Overhead Cable crossing over the LTC mainline, which is in embankment at this point. Pylon affected by LTC earthworks. Cable clearances to proposed levels not available.	BT		Cable clearances not available. Assume 285m underground diversion. Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.
C9-OH07	12+160	182	Overhead Cable crossing over the LTC mainline, in embankment, nearly at ground level. Cable clearances to proposed levels not available.	BT		Cable clearances not available. Assume 182m underground diversion. Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.
C9-OH08	-	273	Overhead Cable crossing over the LTC - A13 slip roads and over the A1013 realignment at ground level. Cable clearances to proposed levels not available.	BT		Cable clearances not available. Assume 273m underground diversion. Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.

ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C9-OH09	17+260	324	Overhead Cable crossing over the LTC mainline, in embankment, nearly at ground level. Cable clearances to proposed levels not available.	BT		Cable clearances not available. Assume 350m underground diversion. Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.
C9-OH10	20+810	391	Overhead Cable crossing over the LTC mainline, which is in embankment at this point. Pylon located in the LTC main alignment. Cable clearances to proposed levels not available.	BT		Cable clearances not available. Assume 350m underground diversion and pylon removal. Engagement and involvement of asset owner (National Grid) to be sought. Construction phasing and site control to comply with asset owner's requirements.
C9-OH11	-	321	Overhead Cable crossing perpendicularly over the LTC to M25 Slip road in viaduct. Cable clearances to proposed levels: OHC Z=29.6 LTC Z=36.4	BT		Engagement and involvement of asset owner (National Grid) to be sought. Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1). Construction phasing and site control to comply with asset owner's requirements.

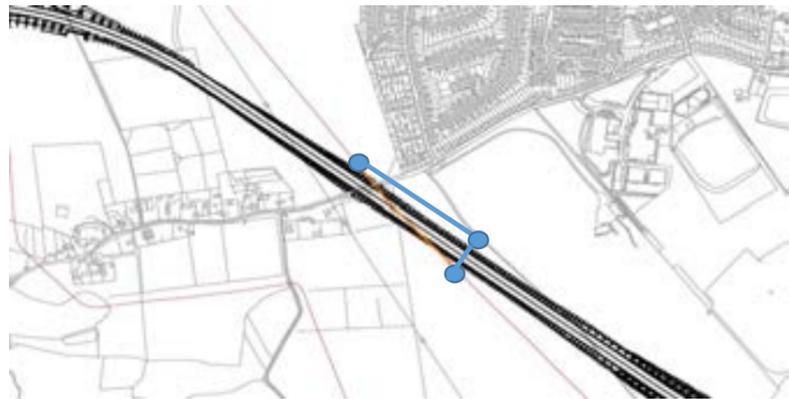
ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C9-OH12	-	393	<p>Overhead Cable crossing perpendicularly over the LTC to M25 Slip road in viaduct.</p> <p>Cable clearances to proposed levels: OHC Z=39.1 LTC Z=39.2</p>	BT		<p>393m underground diversion.</p> <p>Engagement and involvement of asset owner (National Grid) to be sought.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C9-OH13	-	665	<p>Overhead Cable crossing perpendicularly to A226 Realignment, which at that point is at ground level.</p> <p>Pylon AYN041 located in the new alignment of the A226.</p> <p>Cable clearances to proposed levels: OHC z=44.5m LTC z=32.0m</p>	BT		<p>Subject to lateral clearance requirements:</p> <ul style="list-style-type: none"> - No action required - 665m underground diversion and pylon AYN041 removal. <p>Engagement and involvement of asset owner (National Grid) to be sought.</p> <p>Headroom requirements comply with National Grid's headroom requirements from TS43-8 tbl 6.1).</p> <p>Preferences for lateral clearance between towers and the proposed highway to be confirmed to determine if pylon AYN041 needs to be relocated/removed.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

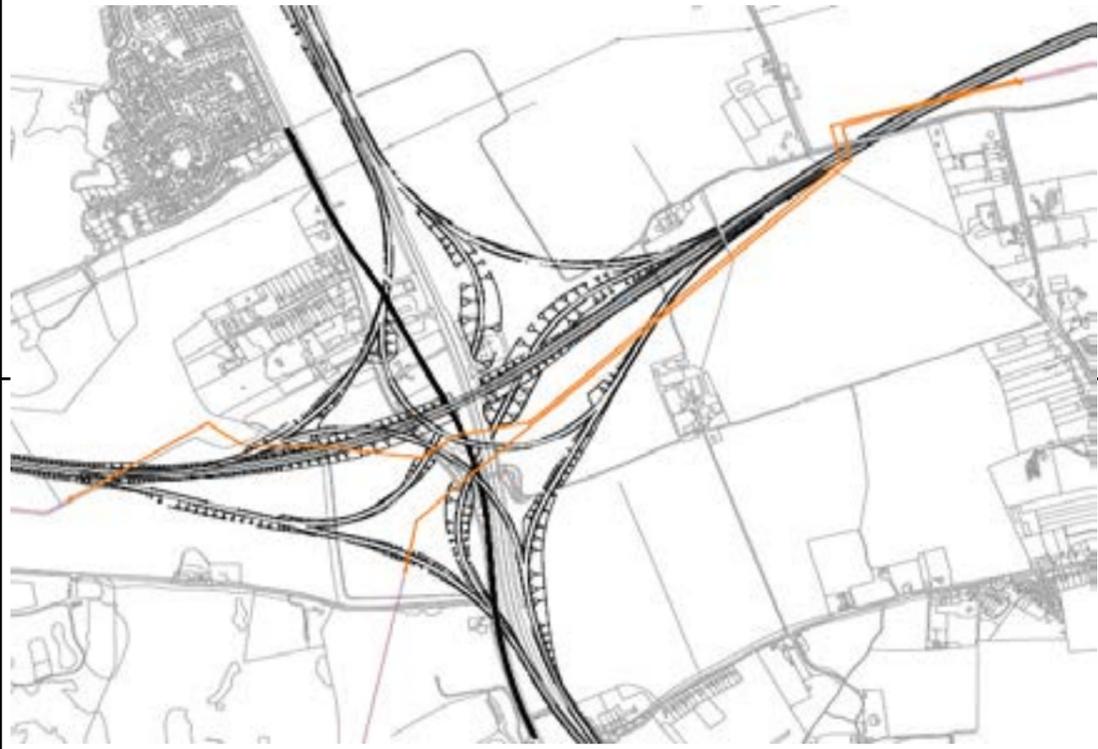
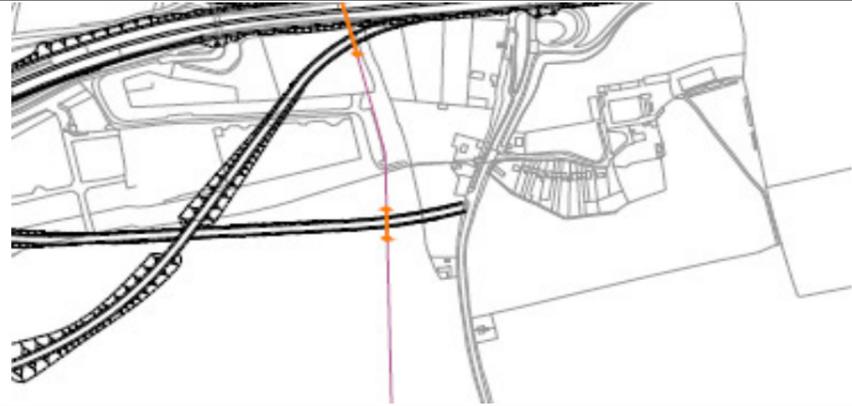
ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Gas mains						
C3-GM01	-	125	Gas feeder affected by A2 and LTC Slip roads. Crossing under the new link road connecting Hever Ct Rd to Brewers road junction in cutting, under the A2 mainline at ground level, and under the A2 eastbound to LTC in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-GM02	-	182	Gas feeder affected by A2 and LTC Slip roads. Crossing under the new link road connecting Hever Ct Rd to Brewers road junction in cutting, under the A2 mainline at ground level, and under the A2 eastbound to LTC in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-GM03	-	430	Gas feeder affected by A2 and LTC Slip roads. Crossing under the A2 eastbound to LTC slip road, under the LTC mainline, and under the LTC to A2 eastbound slip, all of them in embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

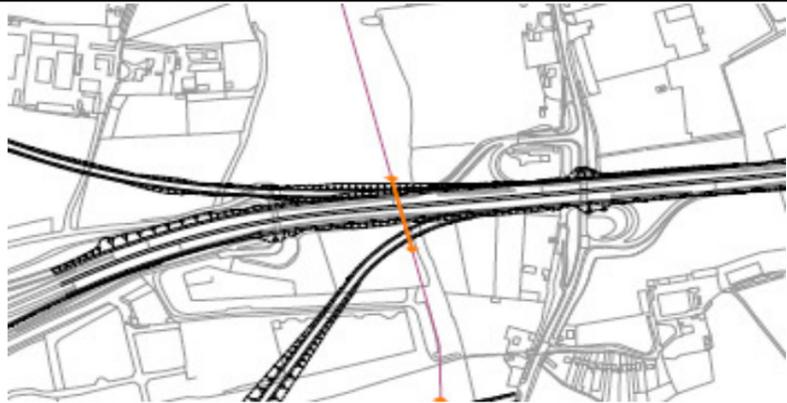
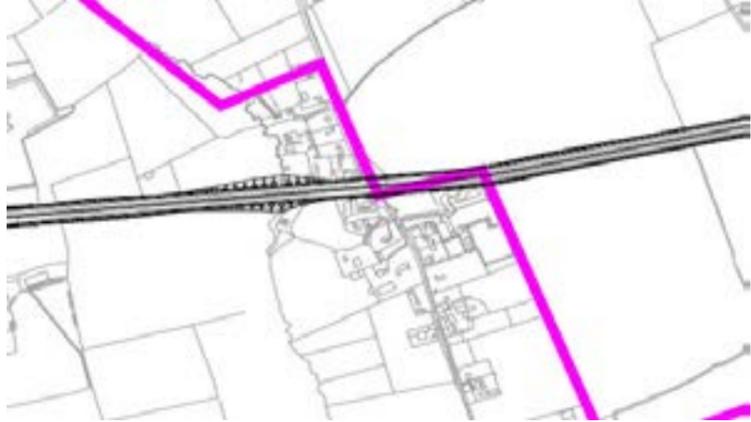
ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C3-GM04	1+000	298	Gas feeder crossing under the LTC Mainline in cutting	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Pipe likely to be affected, in which case a suitable diversion will need to be proposed and the pipe level lowered under the mainline level.</p> <p>Subject to Gas Feeder level and required clearance:</p> <ul style="list-style-type: none"> - None - 380m underground diversion under LTC level <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

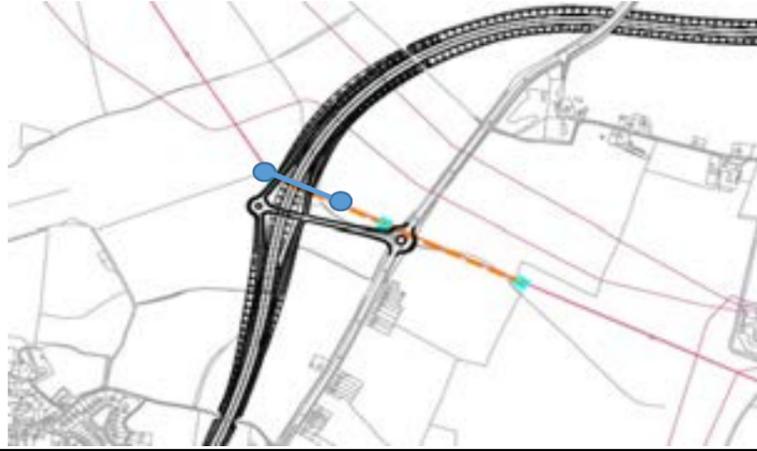
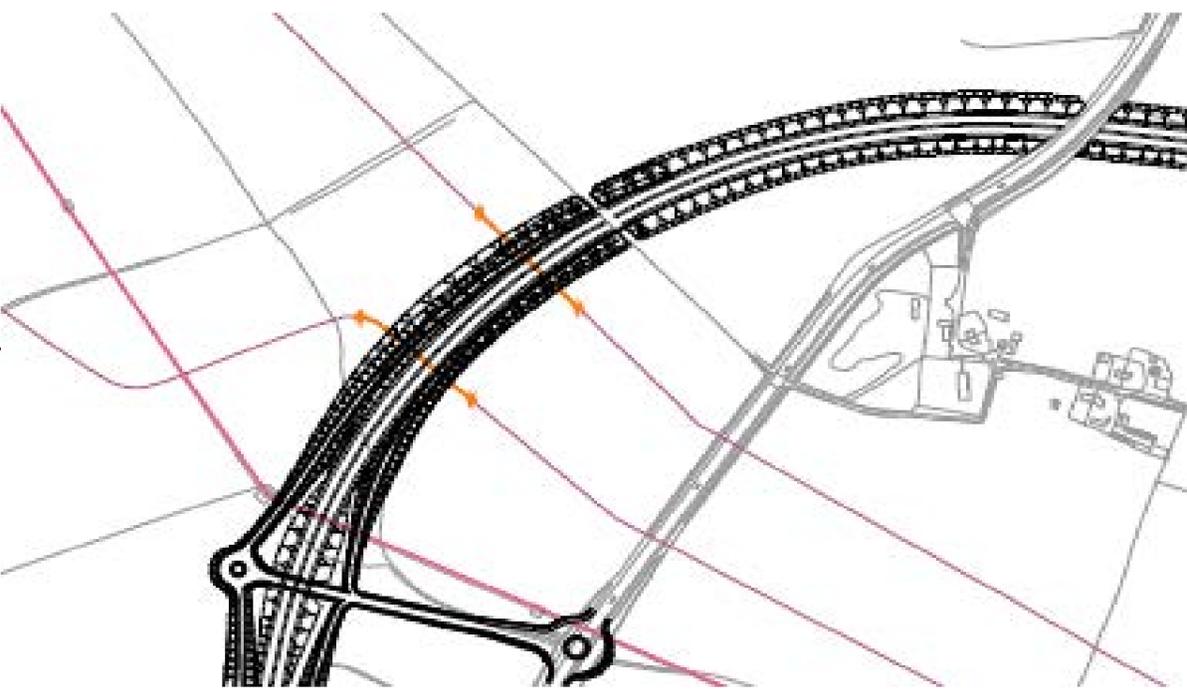
ROUTE 4 MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C3-GM05	12+710	2450	Gas feeder affected by A13 and LTC Slip roads. Crossing under the LTC in embankment, under the LTC northbound to A13 westbound slip in embankment, under the A13 eastbound to LTC southbound slip in cutting, under the LTC northbound to A13 westbound slip in viaduct, under the LTC southbound to A13 westbound, under the A13 westbound to LTC northbound slip in cutting, and under the LTC southbound to A13 eastbound slip at ground level.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-GM06	13+410	1840	Gas feeder affected by A13 and LTC Slip roads. Crossing under the A13 westbound to LTC southbound slip in embankment, under the A13 westbound to LTC northbound slip in cutting, under the LTC northbound to A13 eastbound slip in viaduct, under the LTC southbound to A13 westbound slip in viaduct, and under the LTC southbound to A13 eastbound slip at ground level.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-GM07	26+410	45m	Gas feeder crossing under the link road between the B187 and the Junction 29 at ground level.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

ROUTE 4 MAJOR UTILITIES AFFECTED

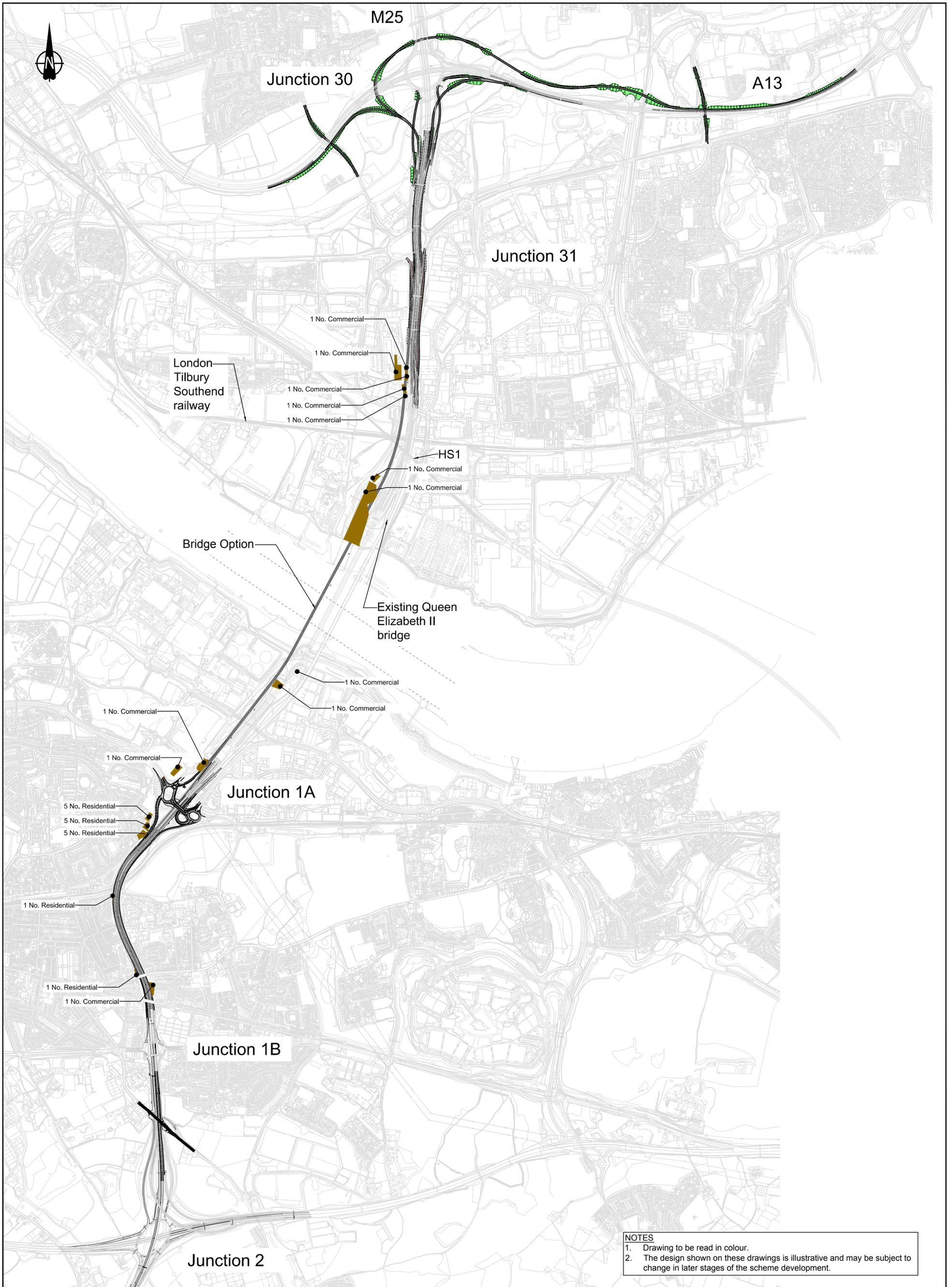
REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
C3-GM08	26+410	110	Gas feeder affected by A127 widening. Crossing under the LTC mainline in embankment, under the M25 to LTC slip at ground level, and under the M25 to LTC slip embankment.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-OP01	17+660	55	BPA Fuel line crossing under the LTC mainline in embankment, nearly at ground level.			<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>
C3-OP03	25+010	243	BPA Fuel line crossing under the A127 Widening at ground level.			<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits. Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p>

EASTERN SOUTHERN LINK MAJOR UTILITIES AFFECTED

REF	CHAINAGE	DISTANCE AFFECTED	DESCRIPTION	CROSSING OPTION AFFECTED	LOCATION PLAN	ACTION
Overhead cables						
C19-OH01	3+100	667	<p>Overhead Cable crossing perpendicularly over the LTC mainline in embankment, over the A226 to LTC northbound slip in embankment, and over the LTC to A226 slip at ground level.</p> <p>Overhead Cable affecting A226 - LTC Slip roads.</p> <p>OHC z1=44.5m, z2= 39.9m, z3=37.1m LTC z1=29.9m, z2=39m, z3=32.9m</p>	BT		<p>Engagement and involvement of asset owner (National Grid) to be sought.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p> <p>220m underground diversion under LTC mainline.</p>
Gas mains						
C19-GM01	3+300	150	Gas feeder crossing under the LTC mainline, and the A226 - LTC slips in cutting.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p> <p>Subject to pipe level confirmation: 150m diversion at a greater depth.</p>
C19-GM01	3+500	150	Gas feeder crossing under the LTC mainline, and the A226 - LTC slips in cutting.	BT		<p>Positive identification of line and level required to inform onward design development - GPR/Trial pits.</p> <p>Proposed drainage, comms and ancillary infrastructure to be designed to avoid affecting pipeline.</p> <p>Engagement and approval of asset owner (National Grid) to be sought.</p> <p>Protection works and/or diversion to be implemented on the advice of the asset owner.</p> <p>Construction phasing and site control to comply with asset owner's requirements.</p> <p>Subject to pipe level confirmation: 150m diversion at a greater depth.</p>

Appendix 4.4 – Affected Properties

Location A Route 1 (Bridge & Tunnel) Demolished Properties Plan
Route 3 Demolished Properties Plan
Route 4 Demolished Properties Plan



NOTES
 1. Drawing to be read in colour.
 2. The design shown on these drawings is illustrative and may be subject to change in later stages of the scheme development.

P02	S5	12-08-16	POST CONSULTATION SAR ISSUE	BHB	MR	GH
P01	S5	15-01-16	SAR Issue	PMN	LG	KC
Rev	Status	Rev. Date	Purpose of revision	Drawn	Check'd	Apprv'd

LEGEND:
 Property demolished

ILLUSTRATIVE DESIGN

Client

Halcrow Hyder Joint Venture
 Burderop Park
 Swindon, SN4 0QD
 Tel. +44(0)1793 812479

Project LOWER THAMES CROSSING

Drawing title Location A Route 1 Demolished Properties Plan

Status	S5	Revision	P01	
Scale	NTS	Date	-	
Drawn By	P. McNulty			
Checked By	L. Gocool			
Approved By	K. Chapman			
Project No.	HA PIN HA540039	I Originator	HHJ	
Drawing number	ZZZ-AZZMLZZML-DR-SE-0001		Original Size	A1



1 No. Residential properties
Hall Farm
New M25 Junction

Whitfields Farm
Baker Street
Mill House
Stifford Church Road
Little Wellhouse Farm
Grey Goose Farm
Five Chimney Cottages
White Crofts
Long Lane
Upgrade A13 Junction

2 No. Residential properties
7 No. Residential properties
2 No. Residential properties
1 No. Agricultural
2 No. Agricultural
2 No. Residential properties
Approximately 22 No. properties on Travellers site (Mixture of static caravans and domestic brick buildings)
2 No. Residential properties

Shorne West
Wood Farm
Claylane Wood
Cheneys
Jeskyns Country Park
Western Southern Link

2 No. Residential properties
1 No. Commercial (Garden centre)
2 No. Residential properties
1 No. Commercial
1 No. Commercial (Service station)

Great Crabbles Wood
Furze Bank
Boysd
Crutches Lane
A289
Eastern Southern Link

2 No. Residential properties
1 No. Commercial properties
2 No. Residential properties
6 No. Residential properties
1 No. Commercial property

ILLUSTRATIVE DESIGN

LEGEND:
■ Property demolished

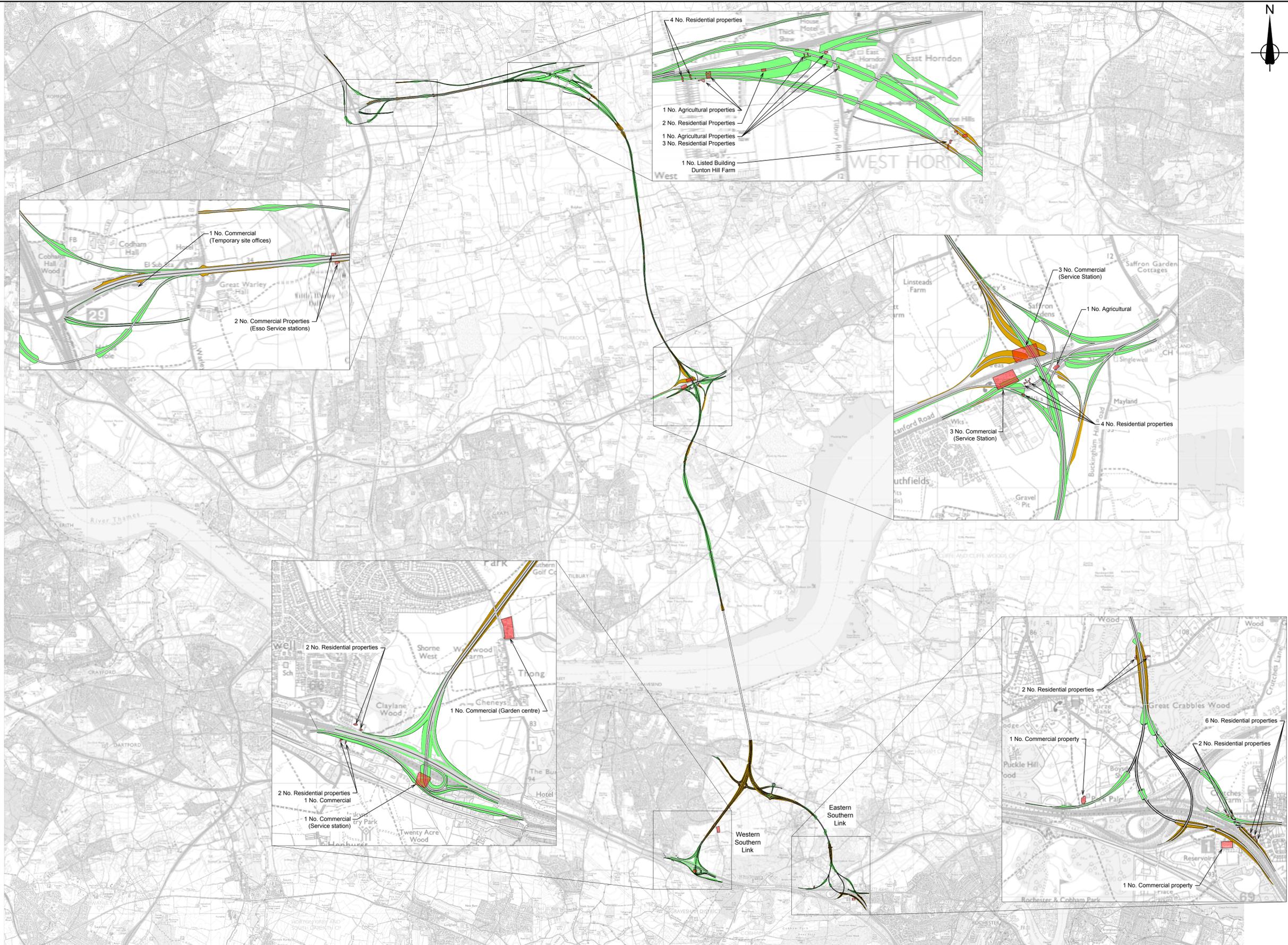
NOTES:
1. The design shown on these drawings is illustrative and may be subject to change in later stages of the scheme development.

P02	S5	12-08-16	Post Consultation SAR Issue	BDC	MR	GH
P01.1	S5	18-01-16	SAR ISSUE	MEC	MR	GH
Rev	Status	Rev. Date	Purpose of revision	Drawn	Check'd	Appr'd

Client
highways england
Halcrow Hyder Joint Venture
Burdorpe Park
Swindon, SN4 0QD
Tel. +44(0)1793 812479
Halcrow Hyder

Project
LOWER THAMES CROSSING
Drawing title
Route 3 Demolished Properties Plan

Status	S5	Revision	P01.1
Scale	As Shown	Date	05-10-15
Drawn By	E Basketter		
Checked By	M Robinson		
Approved By	G Hodge		
Project No.	HA PIN HA540039	Originator	HHJ
Drawing number	HML-CD3MLZZZZ-SK-SE-0001		
		Original Size	A1



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LEGEND:
■ Property demolished

NOTES:
 1. The design shown on these drawings is illustrative and may be subject to change in later stages of the scheme development.

ILLUSTRATIVE DESIGN

P02	S5	12-08-16	Post Consultation SAR Issue	BDC	MR	GH
P01	S5	12-01-16	SAR ISSUE	MEC	MR	GH
Rev	Status	Rev. Date	Purpose of revision	Drawn	Chk'd	Appr'd

Client

Halcrow Hyder Joint Venture
 Burderop Park
 Swindon, SN4 0GD
 Tel. +44(0)1793 812479

Project **LOWER THAMES CROSSING**

Drawing title **Route 4 Demolished Properties Plan**

Status	S5	Revision	P01
Scale	As Shown	Date	05-10-15
Drawn By	E Basketter		
Checked By	M Robinson		
Approved By	G Hodge		
Project No.	HA PIN HA540039	Originator	HHJ
Drawing number	HML-CD4MLZZZZ-SK-SE-0001		
		Original Size	A1

A4.5 Cost Estimating Methodology

A4.5.1 Capital Cost Estimates

A4.5.1.1 Assured capital cost range estimates have been developed in accordance with Highways England Commercial Services Division's standard practice for the Project Control Framework (PCF) *Options Phase* for each of the following Post-Consultation Appraisal Routes:

- Route 1 Cable-stayed bridge
- Route 3 Bored tunnel with Western Southern Link
- Route 3 Bored tunnel with Eastern Southern Link
- Route 4 Bored tunnel with Western Southern Link
- Route 4 Bored tunnel with Eastern Southern Link

A4.5.1.2 The bored tunnel for Routes 3 and 4 was the future-proofed dual three lane tunnel. All other highway infrastructure was for a dual two lane all purpose road.

A4.5.1.3 Range estimates have been prepared using three point estimating techniques with outputs based on 10% (P10), Most Likely (Mode) and 90% (P90) levels of probability. The cost estimate structure consists of the following components:

- Base cost estimate
- Project-level risk and residual uncertainty assessment
- Roads Portfolio-level risk assessment
- Inflation to out-turn prices (nominal terms)

A4.5.1.4 All costs have been estimated in real terms at a price base of Q1, 2014 prior to the application of inflation to the forecast year of expenditure to produce out-turn cost estimates in nominal terms.

A4.5.1.5 Cost estimates are based on the engineering solutions shown in Volume 3 Appendices. Construction methodology and planning assumptions were agreed in consultation with the design team for the basis of estimates.

A4.5.1.6 The estimates have adopted a work breakdown structure aligned to the Project Control Framework as follows:

- Historical costs based on recorded spend to date.
- Options Phase costs based on current forecast of expenditure to the planned completion of the Options Phase and identification of preferred option.
- Development Phase based on an assessment of costs for the Development Phase workstreams covering Preliminary Design, Statutory Process, Procurement and Construction Preparation. Estimates for the Development Phase assume development of a single preferred scheme and delivery of consents through a DCO process.

- Indicative estimates of land purchase and compensation costs have been based on an assessment of affected land by the District Valuer. Close reference has been made to rates used for the HS2 project.
- Lands Costs based on reports and estimates prepared by the District Valuer.
- Costs of construction including direct costs, preliminaries and contractor's overheads and profit:
 - Cost estimate rates for standard highways works are based on Highways England Commercial Services Division current rate database with a price base date for the capital cost estimates is January 2014. A specific assessment of rates for non-standard works items with rates rebased to Q1, 2014 prices. Indicative construction programmes and preliminary construction methodology assumptions for the river crossing options were provided for the basis of the estimates.
 - It was assumed that the construction of each route option would be delivered through three works packages advised by the Delivery Planning workstream:
 - Northern links and junctions
 - Crossing
 - Southern links and junctions
 - Procurement and Construction Phase estimates assume the crossing works are procured on a design and build basis.
- Statutory Undertakers' costs of protecting and diverting utilities services were based on a schedule of utilities works setting out assumed requirements developed from C2 enquiry responses and data received from the utility companies.
- Works supervision, third party fees and ancillary costs including Non-Recoverable VAT based on an assessment of forecast expenditure outside the existing highway boundaries to calculate VAT at current rates.
- Project Risk has been assessed based on assessment of the project risk register and risk workshops to identify risks for each route and crossing solution.

A4.5.1.7 The estimates also include an assessment of Portfolio-level risk, i.e. risks that act across the Roads Portfolio rather than specific project risks.

A4.5.1.8 Inflation has been applied using the Commercial Services Division's inflation profile previously set with the Department for Transport. This has been compared with the most recent Infrastructure UK forecast which is broadly similar up to 2020/21 (the extent of the Infrastructure UK forecast).

A4.5.1.9 A comparison with costs reported from other recent bridge and tunnel projects of comparable scale and nature, including projects in Europe and elsewhere in the world, was carried out as part of the review of the

assured costs.

A4.5.2 Operation and Maintenance Cost Estimates

- A4.5.2.1 Operation and Maintenance (O&M) cost estimates have been prepared for each Post-Consultation Appraisal Route considered in the SAR. The O&M estimates costs are for the incremental costs of operation and maintenance post-implementation of each scheme compared with do-minimum base case of the existing road network layout.
- A4.5.2.2 The assessment period for O&M costs has been set at 60 years across the project, as described in HM Treasury Green Book and WebTAG, with Year 1 being the year of road opening.
- A4.5.2.3 O&M estimates have been produced in real terms at a price base of Q2, 2025, reflecting the typical planned date of completion of construction across the options. Discounting factors have been applied as set out in HM Treasury's Green Book: Appraisal and Evaluation in Central Government, i.e. discount factors of 3.5% for years 1-30 and 3.0% for years 31-60 of the assessment period.
- A4.5.2.4 O&M estimates were prepared net of relative price growth and risk/optimism bias so that the economic assessment could apply these as necessary for consistency with the treatment of these factors in Volume 5 and elsewhere.
- A4.5.2.5 O&M estimates have been calculated based on assessment of incremental cost for each of the following scope categories:
- Routine operation and maintenance activities (e.g. winter maintenance, road sweeping, litter picking, grass cutting, routine inspection programmes, energy costs and core operation and incident response capability, etc...). Note vehicle operating costs and the costs of traffic delays at roadworks are excluded and assessed elsewhere through the scheme's traffic modelling and economic assessment work.
 - Asset renewals, e.g. such as pavement resurfacing, replacement of safety barriers, bridge bearing replacement, tunnel electrical and control system replacements, etc.
 - Betterment that may result from the scheme's replacement of ageing infrastructure with new assets and improved efficiency of future operation and maintenance working practices. This is limited for the Lower Thames Crossing scheme as the vast majority of works are to establish new assets, however, there are minor areas of resurfacing of the existing network and removal of some assets from the existing maintenance burden.
- A4.5.2.6 The difference in complexity of operation and maintenance for the crossing sections compared with the more standard highways works to the north and south of the River Thames has been reflected in the estimating methodology for each of these categories.
- A4.5.2.7 O&M estimates for the standard complexity highways works to the north and south of the River Thames are based on a take-off of principal

quantities for each Post-Consultation Appraisal Route. Annual routine operation and maintenance costs have been estimated based on applying a unit rate per square metre of carriageway derived from annual lump sum charges from existing Highways England Area maintenance contracts. This includes an uplift of 25% for location factors.

- A4.5.2.8 The estimates of routine operation and maintenance for standard highways works assume that the scope of these activities will be similar to existing operation and maintenance regimes. Similarly, it is assumed that required asset condition, service levels, deterioration profiles and maintenance strategies will be similar to existing requirements.
- A4.5.2.9 Periodic asset renewal costs for standard highways assets have been estimated based on the incremental quantities of assets and set renewal frequencies over the assessment period. Percentage allowances for preliminaries and traffic management have been applied based on current practice.
- A4.5.2.10 There are numerous highway structures required north and south of the Thames crossing for each route. Structures' O&M requirements are variable and O&M costs sums have been allowed for structures (other than the main crossing) on the basis of a conservative fixed percentage of capital cost pending design development.
- A4.5.2.11 For the complex crossing structures, O&M estimates are based on specific assessment of routine activities and asset renewal frequencies for each asset type.
- A4.5.2.12 Conservatively, year-on-year efficiency improvements over the assessment period with a gradual reduction in rates have not been assumed. This is naturally difficult to assess with confidence and no allowance for efficiencies is proposed at this stage.
- A4.5.2.13 Reference was made to costs for operating and maintaining the existing Dartford Crossing where relevant but it is noted these costs are significantly affected by the age of the existing Dartford Crossing tunnels and care needs to be taken in comparing with costs for operating and maintaining a new tunnel designed to modern standards and reflective of latest industry best practice.

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